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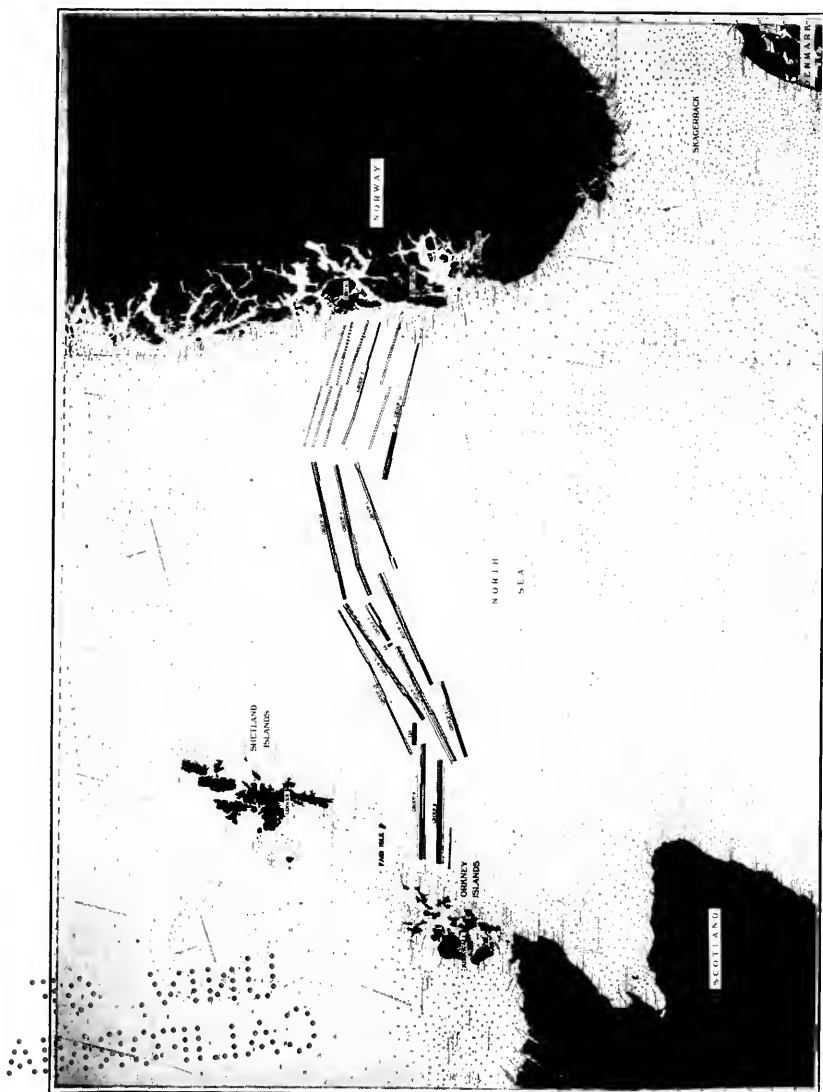
"THE NORTHERN BARRAGE"
(TAKING UP THE MINES)

Published under the direction of
The Hon. JOSEPHUS DANIELS, Secretary of the Navy



WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

July 27
Saturday



The North Sea mine barrage consisting of 56,611 American and 13,652 British mines. The dotted lines indicate British mine fields.

Frontispiece.

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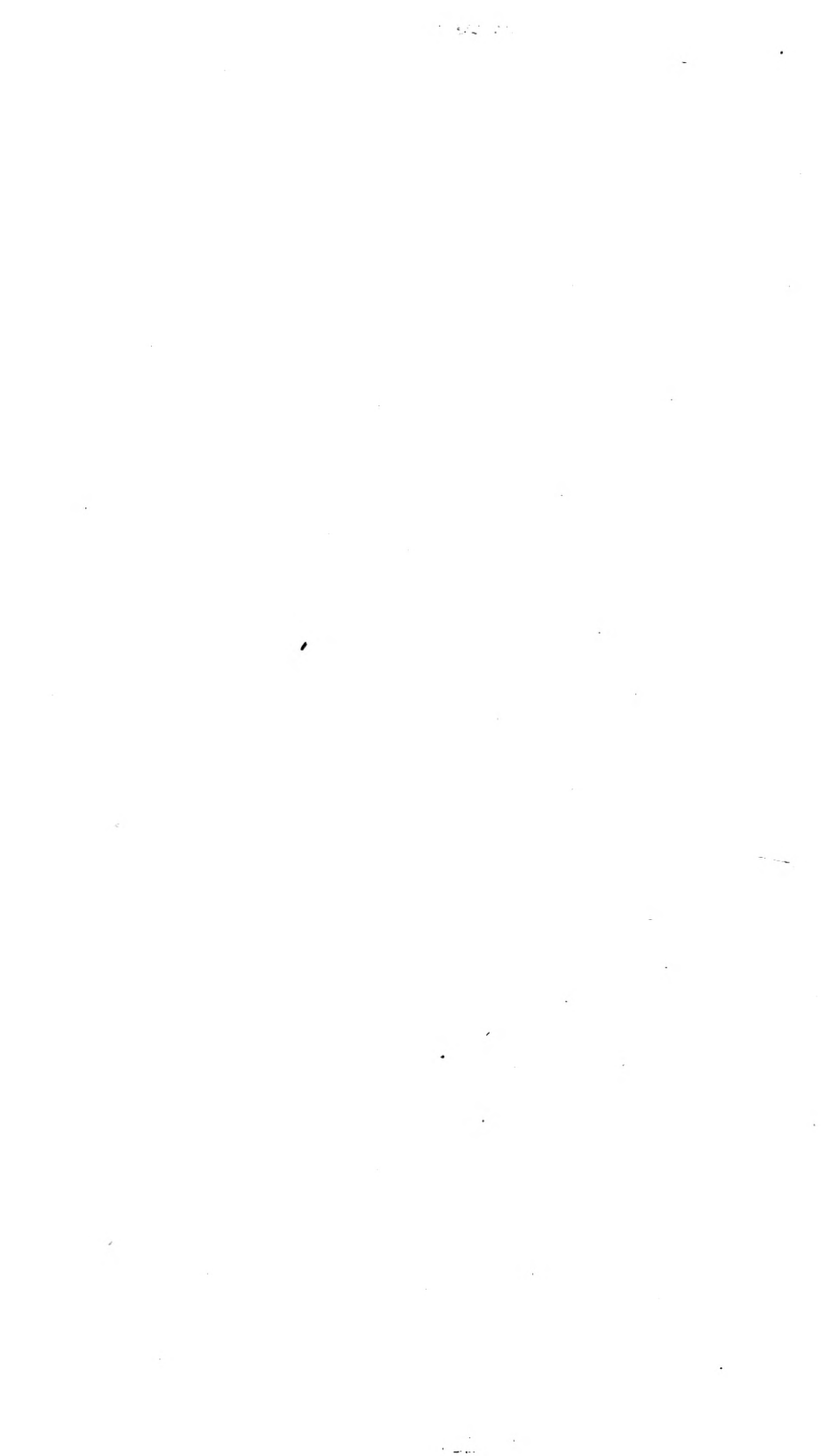
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THE NORTHERN BARRAGE.

Taking Up the Mines.

CHAPTER I.

EARLY EXPERIMENTS IN THE BARRAGE AND THE DEVELOPMENT OF A METHOD OF SWEEPING THE MINES.

Even before the end of the war was clearly in sight it was recognized that one of the most seriously urgent duties of reconstruction would be to clear the seas of mines. Few dangers more treacherous than mines jeopardize the safety of ships and the lives of mariners in time of peace, for, aside from the actual areas in which mines had been laid, thousands of them break adrift and, carried by the wind and currents, infest the neighboring waters for miles around.

Although the subject of who would be required to sweep the various areas of mines had been broached on several occasions, it was not until the latter part of October, 1918, that the questions were definitely considered. Since it was then evident that an allied victory and the cessation of hostilities was only a question of weeks, an allied naval council was convened in London on October 31, 1918, to consider what portions of the mined areas should be cleared by each nation, together with an international method of disseminating all possible data relative to dangerous waters and the routing of merchant ships with the maximum safety.

Capt. R. C. Bulmer, United States Navy, and Capt. J. W. Timmons, United States Navy, were appointed members of the council to represent the United States Government. With the exception of the North Sea mine barrage, the Dover barrage, and the miscellaneous mine fields in the Helgoland Bight, the contemplated mine-sweeping operations in general consisted primarily of exploratory sweeping to make certain that the specified areas were clear of mines. The North Sea barrage was the primary consideration, for here alone were concentrated over 70,000 American and British mines. Of these over 80 per cent had been laid by the United States Navy, and, aside from the huge number, the American mine presented almost insurmountable difficulties from a standpoint of sweeping on account of its novel type and sensitive firing device. Although the policy of the council throughout its proceedings consisted in allocating to the Allied,

Associated, and Central Powers the clearance of the waters bordering their individual seacoasts, the problem of clearing the American mines from the North Sea could not easily be assigned to either Great Britain or Germany. The United States therefore accepted the responsibility of removing all the mines that she had laid, as well as any she might lay in the future. Great Britain similarly agreed to remove the British mines from the barrage.

The tasks which faced the two nations who had pledged themselves to clear the North Sea barrage, were, however, vitally different. To begin with, four American mines had been laid for every one that Great Britain had put down. Then, too, Great Britain had had extensive experience during the war in sweeping the same types of mines which she had laid; she possessed a class of mine-sweeping vessels with very shallow draft, specially constructed for work of exactly this nature; and, moreover, the work to be done was all within close proximity to her coasts and operating bases.

On the other hand, there was no known method of sweeping the mines which the United States had laid. Built on an entirely new principle, these mines had made the construction of the North Sea barrage possible, for a long antenna stretching up above the mine enabled it to do the work for which three or four had previously been required. Now this same feature became our greatest problem. With the uppermost end of the antenna at an average of 8 to 10 feet below the surface of the water, it was impossible for a steel vessel to pass over and strike the mines without exploding them. A piece of iron or steel no larger than a nail was sufficient to operate the delicate firing mechanism. None but wooden vessels would be safe in such a mine field, and then only provided that no metal projections, however small, were exposed on the hull of the ship. Another handicap to be considered was the distance (3,000 miles) of the operating base from our coast.

Almost simultaneously with the commencement of minelaying the British Admiralty had shown signs of anxiety as to what means could be employed to render vessels safe which might be required to clear a passage through the barrage in case of a fleet action or when it should become necessary to clear away the mines after the war. On June 29, 1918, the Admiralty had inquired of the Commander of the United States naval forces in European waters if any method had been devised for protecting our ships. He knew of none, and after cabling the Bureau of Ordnance, referred the problem to the mine force, United States Atlantic Fleet, who were then in Inverness, Scotland, engaged in laying the barrage.

The problem was not, however, so easily solved as it had at first appeared. The commanding officers of the various minelayers were asked to submit recommendations which, when received, were

all more or less impracticable. In general, the recommendations favored the development of a sweep sufficiently wide to span an entire group of mines and, with this arrangement, to steam down the field and explode the mines by touching their antenna with the sweep wire. Such a scheme was practically beyond consideration from the start. The mine fields had an average width of approximately 3,500 yards, and the widest sweep which had up to that time proved practicable varied between 300 and 600 yards, according to the type of craft employed, and even then the depth of the sweep was irregular. To expand this to 3,500 yards, keeping the sweep throughout its length at a uniform depth, would require months of experiments and even then might be found impossible.

Nothing further was done until after the allied naval council had concluded its proceedings and the armistice was signed. Then it came to a crisis. The Commander, Mine Force, Rear Admiral Joseph Strauss, was informed that his organization, which had just completed the construction of the barrage, would be required to remove it. Even though no method was then known for clearing the barrage, it was apparent that the minelayers themselves could not be of service in the mine field with their deep draft. Furthermore, as most of these vessels could be utilized to advantage for transporting troops back to the United States, preparations were commenced for their return. Prior to sailing, however, as it was desired to take advantage of all possible talent which might be useful in obtaining a solution for sweeping the barrage, Admiral Strauss selected a board from amongst the commanding officers of the minelayers to study the question of sweeping the North Sea barrage, and to submit recommendations for its accomplishment. Every possible solution was considered by this board, but the final recommendations submitted were essentially an elaboration of the previous suggestions which had been made. Wooden motor vessels with their propellers guarded from contact with the mines were to be used for exploding the surface mines by contact of the sweep wire with the antenna. After all the surface mines had thus been destroyed, heavy-powered vessels would be free to enter the mine field and sweep the mines which had been planted at the lower levels. It was probable that wooden-hulled vessels of the type suggested could be chartered from the British Admiralty which we could man with our own crews. As this plan was the most feasible one yet proposed, 400 trained petty officers and seamen were taken from the minelayers before their departure and transferred to the bases in order to have experienced personnel on hand as the nucleuses for these crews in case it became necessary to borrow these vessels.

A few days later, December 1, 1918, the minelayers sailed for the United States, leaving the *Black Hawk*, with the *Patapsco* and

Patuxent, behind as the nucleus for the minesweeping force. The *Black Hawk* remained as the flagship and repair ship of this embryo organization, while the *Patapsco* and *Patuxent*, two powerful tugs, were retained to carry out experiments to ascertain, if possible, some means of sweeping the barrage and to develop the gear which would be required.

Since it had not been possible during the mining operations, to grant leave to any of the officers or men on account of the uncertainty of movements, the squadron was sent to Plymouth for a brief stay in order that all hands might have an opportunity to visit England before returning to the United States.

In the meantime a possible solution for protecting vessels in the mine fields had been suggested by Ensign D. A. Nichols, United States Naval Reserve Force, who had been on duty on Admiral Strauss's staff as the assistant communication officer during the minelaying operations. The suggestion consisted of an electrical scheme for blowing up the mines as they came within a given radius of a vessel. If the radius could be made sufficiently large, it would be possible to explode all mines before the sweeping vessels approached close enough to be damaged by the explosion. Experiments were undertaken at once, but although the scheme was sound in principle, the distance at which the mines could be exploded was far too small to enable it to be used without constructing a large elaborate electric installation for the ships, which rendered this scheme prohibitive.

This experiment, however, had no sooner been carried out than the solution, which later became the salvation of the ships which did the work, automatically suggested itself. It consisted merely in reversing the principle of exploding the mines at a distance so that when they were struck by a ship, they would be prevented from exploding. During the early part of December every conceivable test was carried out in order to prove conclusively that no false assumption had been made, but every test proved more substantially that the application was fundamentally sound and thoroughly effective. Not only did the scheme prevent the mines from firing which were actually struck by a ship, but also a partial effect was produced on the mines within a radius of many feet around the vessel's hull, which rendered them less susceptible to firing.

Here, at last, was the solution of the greatest difficulty with which we were faced in connection with sweeping of the North Sea barrage. Not only did it make it possible to use powerful steel vessels, but it enabled us to use our own craft instead of being faced with the embarrassment of having to call upon the British Government to furnish vessels to do the work which we had promised to perform, for the new American minesweepers which had been placed under construction during the war were now being completed in rapidly increasing

numbers and were of a type admirably suited for the work which we had to undertake.

It was January before all the necessary tests in connection with the development of the electric protective device had been completed and the specifications drawn up for its manufacture and installation on the minesweepers. The necessary information, with the details for its manufacture, was cabled to the Navy Department with the request that the manufacture be completed at the earliest possible date in order that the minesweepers which would be allotted for the work might arrive in Scotland by the time that the spring weather would permit operations to be started.

The North Sea weather is notoriously bad throughout the year, but particularly so in the winter months. This, coupled with the few short hours of daylight, makes operations such as sweeping practically impossible for seven months of the year. If the barrage was to be completely cleared during the coming summer—and it was most important that it should be—every possible moment must be utilized. Five months had been required to lay the mines, but the task for removing them was, by its very nature, infinitely more difficult and exacting.

While the electric protective device was being developed, preparations were under way for an experiment of a totally different nature. Since the first mines had been laid in the barrage, there had been no means of telling its effectiveness nor how well the mines with their slender antenna had survived the frequent storms. During the latter part of the summer Admiral Sims had requested the Commander of the Mine Force to make a skimming sweep across the mine field to determine if the mines were still there and effective. Many had exploded shortly after having been laid; others had broken adrift and been discovered on the coast of Norway; there was also a possibility that the batteries which fired the mines had not survived as was intended. It was now more essential than ever to determine the actual condition of the mines in the barrage before sweeping operations were undertaken, and to this end arrangements were made to borrow from the Admiralty two wooden sailing vessels, man them with volunteers, and cross the mine field with a sweep wire between them to find out what percentage of the mines were still in place and effective.

Two Lowestoft fishing smacks arrived at Inverness the latter part of November. Preparations were begun at once to fit them out for the experiment. The *Red Fern* and the *Red Rose*—such were their names—were hauled out upon the ways at Inverness, their seams calked, nail heads driven in, the metal parts sheathed with wood, and then a heavy coating of tar applied—all to prevent mines from exploding when in contact with the hull. Additional billets were fitted to accommodate a crew of 10 men on each vessel, the rigging was

overhauled, and on December 22, 1918, these tiny craft, in tow of the *Patapsco* and the *Patuxent*, set out for the barrage. Lieut. Noel Davis, United States Navy, was in command of the expedition and the *Red Rose*; Lieut. (junior grade) Olaf Maatson, United States Naval Reserve Force, commanded the *Red Fern*.

The *Patapsco* and *Patuxent*, after reaching the southern edge of the mine field, were to stand by while experiments were being undertaken, then render assistance if necessary when the vessels again were off the field.

The next morning found them a few miles to the southward of the first line of mines in the central portion of the barrage. Shortly after sunrise the smacks spread sail, stood up to each other, passed sweep and set course to cross the field of mines. A few minutes before noon, as the vessels crossed the first line of invisible mines, a giant column of discolored water sprang high into the air close astern of the *Red Rose*. The first mine in the North Sea barrage had been swept. Separated as it was from that vessel by only a short length of manila rope, which insulated the sweep wire from her stern, the tremendous shock of the explosion all but crushed the wooden hull of the vessel; water spurted in between the timbers in countless places; the pump was started at once, but was barely sufficient to keep her dry.

It was a pretty sight to see these little craft sailing back and forth across the mine field, wearing and tacking in unison, and keeping station on each other by furling topsails or streaming sea anchors.

In all, the lines of mines were crossed four times; six of the upper level mines were exploded, a negligible number, of course, when compared with the 56,000 mines which had been laid, but it had proved conclusively that the mines were still there, ready to explode upon the slightest contact, and that every possible precaution must be used in the forthcoming operations to guard the lives of the men who would be required to sweep the mines.

By 3 o'clock the sun had set; the *Patapsco* and *Patuxent* were no longer in sight. To add to the difficulties, a storm, which had been foretold by the morning's sky and a rapidly falling barometer, burst with the force of a hurricane. The sweep was cut adrift from the *Red Rose* and *Red Fern*; the vessels headed about and set course to the southward to get clear of the mine fields before the twilight had faded.

The days that followed were days of anxiety at Base 18, and hardship for the crews of the *Red Rose* and *Red Fern*. For three days the storm continued unabated. The *Patapsco* and the *Patuxent* were suffering as badly as or possibly worse than the fishing smacks, and had not been able to locate them after they had left the mine field. Realizing the severity of the weather, Admiral Strauss requested the British authorities to send out such vessels as were available to

search for the sailboats, but the majority of those sent could not weather the seas and were forced to return to port. Then on Christmas Eve, when hope had almost ebbed away, Lieut. Davis telephoned to Admiral Strauss that the *Red Rose*, though badly wrecked by the storm, had managed to reach Peterhead that morning. The next day the *Red Fern* anchored at St. Andrews Bay, having been blown more than 200 miles from her destination.

The next two months were doomed to be months of comparative idleness, so far as actual minesweeping was concerned. The *Patuxent* had lost her rudder during the storm and had to be sent to Newcastle-on-Tyne for repairs. The *Patapsco* alone could not carry out suitable experiments. Even with the *Patuxent*, experiments as complete as was desired could not be made, due to the small electric plants on those two vessels. The *Sonoma* and *Ontario*, as well as four sweepers of the *Avocet* class which were then in the United States, were requested to be sent to Inverness at once in order that further experiments might be conducted and suitable gear developed for the coming sweeping operations. It was replied that none of these vessels could be spared from their present duties. As the most important work was, therefore, to do everything possible to complete the fitting out and installation of the electric protective devices on the vessels which were to be sent to Scotland in the spring, Admiral Strauss decided to return to the United States to push the work and prevent delays arising from questions which would have to be referred to him for settlement. He proceeded to London on December 26, 1918, and arranged to have Capt. R. C. Bulmer, United States Navy, then commanding officer of the *Black Hawk*, appointed Commander, United States Minesweeping Detachment, which was to be a suborganization of the Mine Force.

Numerous minor details had to be completed in Scotland prior to the arrival of the minesweepers in order that everything might be in readiness to commence the operations the moment they arrived. The mine bases at Inverness and Invergordon were to be closed up. There were at that time nearly 13,000 mines and 19,000 mine anchors at the two bases which must be returned to the United States. A total of 2,500 men had been retained in order to have them available for manning the British ships which it had been originally contemplated to take over. New bases had to be selected and prepared, and complete operating instructions planned and ready for issue.

CHAPTER II.

PREPARATIONS FOR THE ARRIVAL OF THE MINESWEEPERS AND THE COMMENCEMENT OF SWEEPING OPERATIONS.

Labor conditions in Great Britain at the beginning of 1919 were critical, and it soon became apparent there would be no possibility of completing the repairs on the *Patuxent* before the end of February. The handicap of having no vessels except the *Patapsco* to experiment with was serious. Sweeping experiments were highly essential preliminary to the actual commencement of sweeping. In the first place, we were required to sweep at a much greater depth than had heretofore been the practice. The lower tiers of mines had been planted 240 feet beneath the surface and the ordinary types of kites were not adapted for sweeping at this great depth on account of the long length of kite wire required, which reduced the effective width of the sweep too much. In the second place, it was desired to develop as broad a sweep as possible. Although the British had not considered it feasible to use sweeps of greater breadth than 500 to 600 yards, it was considered probable that with our powerful minesweepers a considerably wider sweep could be profitably employed. Since we had no vessels available for carrying out these experiments, it was necessary to request the Navy Department to carry them out in home waters. During the latter part of February and the first part of March experiments were conducted for this purpose off the Nantucket coast by the *Heron*, *Oriole*, and *Robin*. These experiments, although of some value, were not in sufficient detail and accuracy to permit definite and complete deductions to be drawn. A maximum width of sweep of more than 2,000 yards was obtained, but the sweeping speed, as well as the depth to which the cod of the sweep sank, unless a prohibitive number of buoys were used, were not permissible for use in the North Sea.

In order to take advantage of any information which the British Admiralty had gained in their sweeping operations during the war, as well as subsequent developments in the tests then in progress, Commander W. L. Beck, United States Navy, who had remained at Base 18 after completion of the mining operations for work in connection with the minesweeping, was sent to the British mining school at Portsmouth to obtain all information possible. The visit was highly profitable and resulted in obtaining the specifications of the

plunger kites which had just been developed and had proved far superior to the old prism type. The plunger kite resembles in shape a section of the wing of an aeroplane, except that it rides upside down in order to fly downward instead of upward. Another point obtained by Commander Beck which was important was the use of right and left hand sweep wire. The effect of the water pressure on the strands of the wire tends to elevate or depress it, according to the angle at which it is being towed through the water. A combination of the two kinds in making up a sweep is therefore necessary in order to keep the sweep at a more nearly uniform depth. By assembling the sweep with the right-hand laid wire for the left half of the sweep and vice versa, the droop of the sweep is almost entirely eliminated when sweeping at a speed of 6 to 8 knots.

Since only one vessel, the *Patapsco*, was available, it was necessary to modify the program of contemplated experiments in order that the one vessel might take the place of two. An actual test of the electric protective device in the mine field was considered essential, but as a further precaution, a preliminary experiment was made by planting four mines, completely assembled, with the exception that the T. N. T. had been replaced by cement, then steaming past them and striking the antennæ to see if the mines would explode while in contact with a ship fitted with the electric protective device. The results of this test, while favorable, were not conclusive, due to the difficulties of observation. It was therefore decided to make a further test of the protective device in the mine field, using a single Actæon sweep to explode the upper level mines by touching their antennæ. The Actæon sweep resembles in principle the paravanes. ~~Down~~ spars fitted with rudders carry the ends of the sweep wires out on each quarter of the sweepers in the form of an inverted "V."

The experiment was carried out the latter part of January in the western part of the barrage. A total of 20 lines of upper level mines were crossed which, with an effective breadth of sweep of 160 yards, should have yielded a maximum number of 33 mines and a minimum of 23. Actually none were exploded. Assuming that the sweep maintained the proper depth (which apparently was so from the measurements taken), it appeared that either the mines were not there or else their antennæ had been carried away during the winter storms. Neither of these conclusions, however, seemed entirely probable, since less than a month prior the *Red Rose* and *Red Fern* had found in their experiment that approximately 28 per cent of the upper level mines were still in place with antennæ intact.

Since no mines were obtained in this experiment the test of the electric protective device was not particularly positive, for the *Patapsco* probably passed over no mines which were sufficiently shallow to come in contact with the hull of the vessel; otherwise they would have been exploded by the sweep.

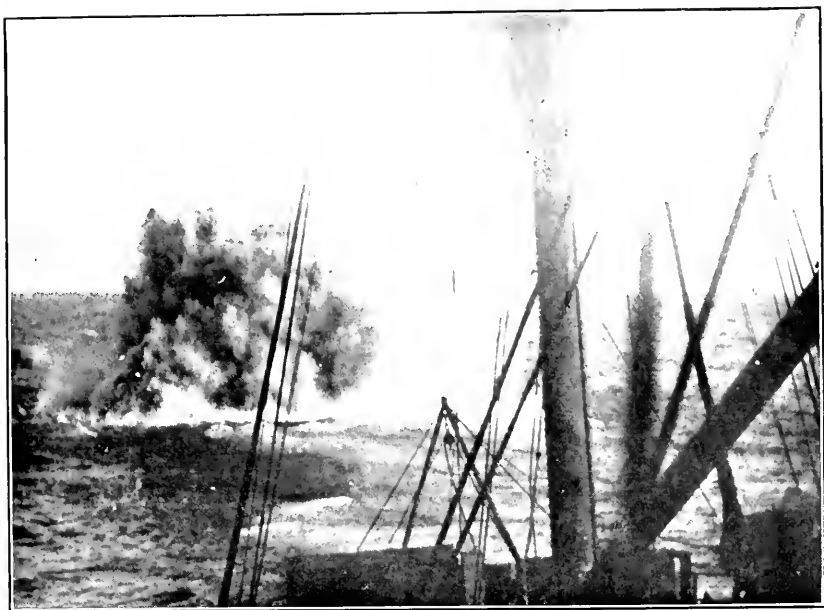
A careful analysis of the contemplated sweeping of the barrage, the difficulties which might be encountered, and the material which would be required had by this time been completed. It was apparent that if the upper level mines had lost their antennæ it would be necessary to cut most of these mines from their moorings in order to remove them. This in turn would necessitate special vessels to sink the mines, and to this end Commander Minesweeping Detachment requested that 20 sub chasers, which were the only type of vessel then available, be sent to Inverness by the 1st of April.

It was estimated that 18 sweepers would be able to complete the clearance of the barrage in the coming summer, provided they arrived by the 1st of April. But since the estimate was not based on a known performance, as many other sweepers as could be spared were asked for in order to insure the completion of the work. The original estimates of the sweep wire and kites which were then considered necessary to clear the barrage were, as it developed later, ludicrously small; three kites per vessel and six complete sweeps for each pair were at that time considered a liberal allowance. When actual operations began more than this entire quantity of kites and half the amount of sweep wire was expended in a single operation.

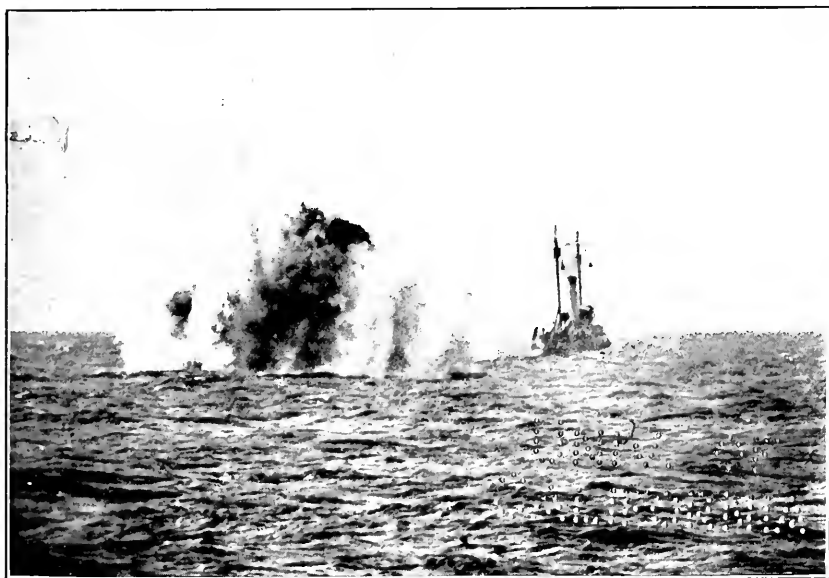
A further development in connection with the electric protective device was tried out during February and appeared at the time to have possibilities for simplifying the sweeping operations. It consisted of a scheme of charging the sweep wire electrically, so that mines would be exploded by striking their mooring cables as well as by striking their antennæ. The tests, such as were possible to make with the limited facilities at hand, were encouraging and the department in Washington was requested to include in the installation on the minesweepers the additional connections necessary to enable it to be used.

The submarine chasers began to arrive at Inverness the latter part of February, and by the 1st of March 19 had reported, including 3 which had previously been sent to Norway for exhibition and possible sale. The highly favorable impression made by these vessels while in Norwegian waters is worthy of note and was the subject of correspondence to the Secretary of the Navy complimenting the commanding officers and the crews on their splendid appearance and capable seamanship.

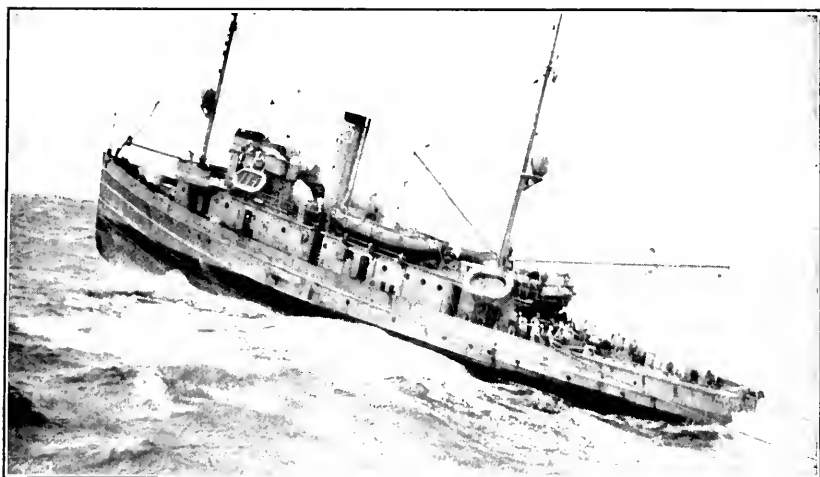
As soon as the sub chasers had arrived at Inverness they were organized into divisions and placed in training for their prospective duties on the mine field. Dummy mines were constructed and target practice was held under adverse weather conditions to enable the chasers to sink mines with the necessary rapidity when they went out with the sweepers. Further drills and instructions were carried out in connection with planting dan buoys and picking them up



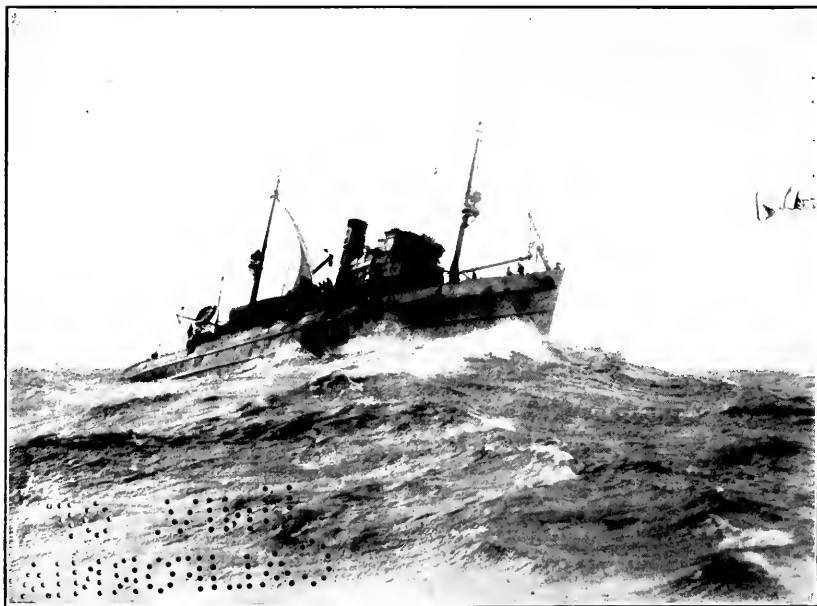
Explosion of mine on contact with sweeping cable electrically charged. (Pages 10-16.)



A mine explosion close astern the U. S. S. Patapsco. The black gases of combustion can be seen in the center of the explosion. (Page 40.)



One of the 54 new American mine sweepers built during the World War. (Page 10.)



The mine sweepers proved to be wonderful sea boats. (Page 10.)



Rough weather in the North Sea. (Page 11.)

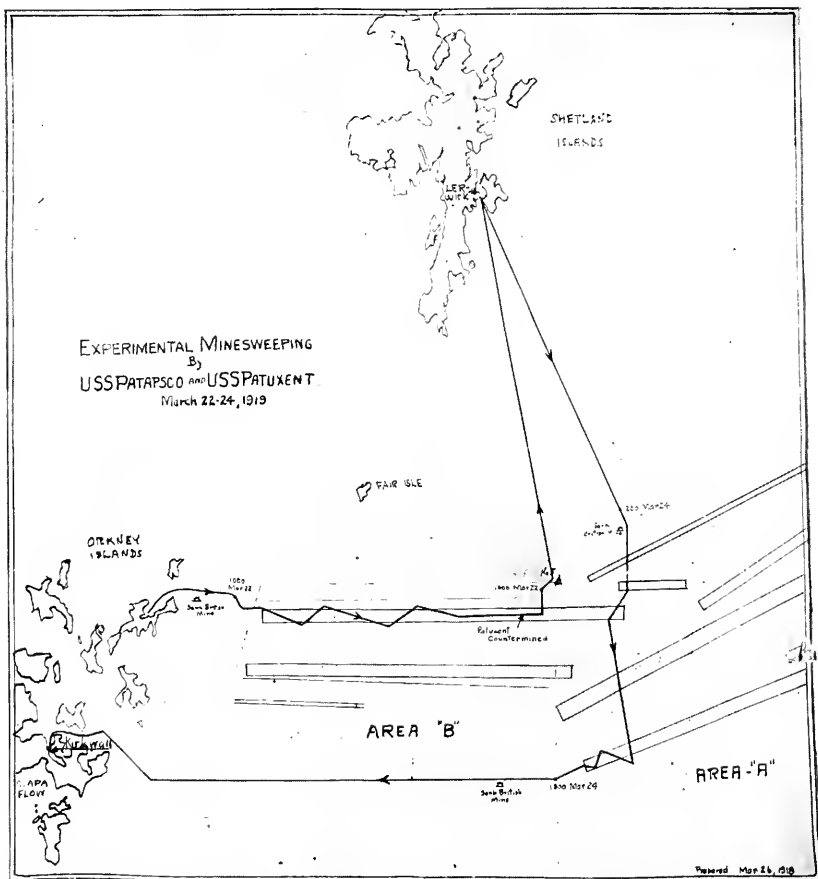


Chart showing experimental mine sweeping by U. S. S. Patapasco and U. S. S. Patuxent, March 22-24, 1919. (Page 17.)

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again, since at this time it was considered probable these vessels would also have to do this work.

While the above work was in progress, arrangements were being completed as rapidly as possible for the demobilization of Base 17 and the reduction of personnel at Base 18 to the minimum necessary to carry out the work in connection with the minesweeping; at that time we contemplated using Base 18 as the primary base for the sweeping operations. The mines at Bases 17 and 18 had all been returned to the United States. On the 1st of March Base 17 at Invergordon had been completely demobilized and was turned over to the British. The Admiralty had already made plans for establishing a permanent mining base at Invergordon and had filled the stowage sheds with their own mines as rapidly as ours had been moved out. On account of the shortage of space, it was also necessary for them to stow large quantities of mining material at Base 18, but on account of its proximity to the city of Inverness, the explosive charges were all sent to Invergordon.

In the early part of February the Force Commander had directed that two nucleus crews be assembled, trained, and held in readiness to man German merchant ships which were being taken over by the United States. The first crew left Base 18 on the 24th of February to man one of these vessels which was then at Liverpool. The second crew remained at the Base until May 3 when it was dispatched to Southend, England, to man the *Brandenburg*.

By the middle of March, repairs on the *Patuxent* having been completed, she returned to Inverness. A homemade electric protective device was installed, and on the 20th of March the *Patapsco* and *Patuxent*, with Capt. Bulmer in command, set out for the barrage to make the first real experiments with the actual gear which was intended to be used in the sweeping operations which were to follow. Two days later the two vessels passed sweep at the western end of group 9 and commenced a zigzag to the eastward along this group. The sweep was regulated to cut the upper and middle level mines adrift and to explode the lower level mines by touching their antennæ.

No sooner had the vessels entered the mine field than the first mine was exploded. The sweeping continued without interruption or serious casualty for several hours. The weather was rough and observations were difficult, but nevertheless mines could be seen rising to the surface astern of the sweep after they had been sawed from their moorings.

Just before reaching the eastern end of the group one mine was exploded in the center of the sweep and almost simultaneously several others exploded in the near vicinity. One was an upper level mine fairly close aboard on the port quarter of the *Patapsco*; two others

were lower level mines whose position at the instant could not be determined. Almost immediately following this series of explosions clouds of black smoke began to pour from the funnels of the *Patuxent* as a widening slick of brown water, marking the explosion of a lower level mine, spread out around her. The mine exploded by the sweep wire had countermined these others, one of which had been directly underneath the *Patuxent*. Lights throughout the vessel had been broken by the shock of the explosion, the floor plates in the firerooms had been thrown from the deck, and other minor casualties throughout the ship had occurred. With the firerooms dark, the floor plates topsy-turvy, it seemed for a moment to the men on board as if the ship was sinking, but regardless of all not a man left his station. The men confined below decks in the firerooms, who were particularly plucky, were later commended for their action by the Secretary of the Navy.

We had experienced a danger which later was to become one of the most serious which had to be faced. No conceivable effort could eliminate the possibility of one mine countermining others. Against this condition the electric protective device was useless. A mine planted at the lowest level had caused considerable damage aboard the *Patuxent*. It seemed most probable that had it been an upper level mine the ship would have been sunk.

A few moments after the *Patuxent's* shock another mine was exploded by the sweep, which fractured the sweep wire and necessitated leaving the field, so that it might be repaired in safety. Before this could be done, however, a blinding snowstorm had overtaken the two vessels, and since it was nearly dark, course was set for Lerwick, the principal town in the Shetland Islands. The next day the port was inspected by Capt. Bulmer with a view of using it as a base for the minesweeping operations.

The following morning the *Patapsco* and the *Patuxent* returned to the mine field and made further experiments, then proceeded to Kirkwall in the Orkney Islands to make a similar inspection. Upon completion of the inspection Capt. Bulmer paid his respects to the rear admiral at Scapa, who was also in command of the British naval base at Kirkwall, then returned with the two tugs to Inverness.

In the two days' sweeping 21 American mines had been exploded and 17 more were definitely known to have been cut adrift. It was probable that on the first day, when the weather was rough, considerably more were cut adrift but could not be observed on account of the waves and the whitecaps. Several British floating mines were sighted during the operations and sunk by rifle fire.

The experiment had been satisfactory in every particular; several upper level mines which were cut up were seen to possess their complete antennæ. It was therefore probable that one of the two

vessels, at least, had actually passed over mines of this nature without exploding them, due to the effectiveness of the protective device. On account of the inadequate gear available, it was not possible to try out the scheme of using the charged sweep for exploding the mines by contact of the sweep wire with their mooring cables. The type 7 plunger kites, as well as the arrangement of the sweep, which was an innovation in mine sweeping, had proved entirely satisfactory, and it was considerable relief to know that the large quantities of gear and material which had had to be ordered without opportunity for experiment in advance would be entirely satisfactory.

In the meantime preparations in the United States were rapidly reaching completion. Commander B. L. Canaga, who had been on duty with the mining squadron during the construction of the barrage, had been ordered to duty at Boston in connection with the fitting out of the minesweepers at that yard, and, upon completion, to duty in command of a division of the sweepers. Commander W. F. Jacobs, who had been with the mining squadron, was later ordered to similar duty at the Norfolk Navy Yard. By April 6 the first 12 sweepers had left Boston and headed for Inverness. Eight days later they were followed by four more. The sweep wire, kites, insulated kite wire and miscellaneous accessories had been completed and placed on board the sweepers prior to their departure. Additional supplies and material, including 2,000 34-inch sphero-cylindrical buoys for possible use buoying sweep wires, had been sent on the *Lake View*.

At Inverness the preparations were equally well along; it had been decided to use Kirkwall as the primary base for operations on account of its proximity to the barrage. Arrangements had been completed to obtain from the British Admiralty an oil ship, water boat and gasoline boat, also to obtain coal from the British coal barges which were maintained at Kirkwall. But since the transportation facilities from Great Britain to Kirkwall were so inadequate Base 18 was to be used as a receiving base for the constant train of supplies which were required at Kirkwall. Vessels of our own force would transport the supplies between the two bases. Also since the hospital facilities available on the *Black Hawk* were far too small for the entire force, it was necessary to retain those at Base 18 to handle the more serious cases as they occurred. All subchasers had undergone thorough repairs on engines and hull in preparation for the strenuous duty they were to perform. Special large scale charts of the mine field had been requested from the British hydrographer and were completed just prior to the arrival of the sweepers. Administrative instructions and organizations had been prepared and printed, ready for issue as soon as the vessels should arrive. Additional light buoys had been laid to mark the boundaries of the North Sea barrage, and special

dan buoys had been purchased from the Admiralty for use in connection with the sweeping operations.

The Y. M. C. A. had sent a hut to Kirkwall, where it had been erected by our men sent from Inverness, so that that organization would be prepared to entertain our men as soon as we arrived. Later the Knights of Columbus also established themselves at Kirkwall, and throughout the summer the hospitality offered by those two huts, together with their entertainments and dances, played a very important part indeed in brightening the months spent in this far and not altogether attractive corner of the world.

In the early morning, the 20th of April, the first 12 sweepers dropped their anchors in Inverness Firth. A few hours later, Admiral Strauss, who had crossed by passenger boat, arrived in Inverness and hoisted his flag immediately on the *Black Hawk*. His instructions were brief: operations were to begin at the earliest possible moment, and every effort must be made to complete the clearance of the North Sea barrage that year, taking due precaution for the safety of the vessels and their crews.

CHAPTER III.

THE FIRST MINE-SWEEPING OPERATION.

Although it was of the utmost importance to complete the removal of the barrage during the summer of 1919 in order that no mines which might be dangerous to shipping would remain unaccounted for during the winter months, when work would be impossible, there was still a higher principle which must take precedence in planning the sweeping operations—the war was over and human life, which for nearly five years had been practically valueless, had at last returned to par. The clearance of the barrage was a peace-time operation and the lives of the men who were required to do the work must be guarded above all else.

A board was accordingly appointed by Rear Admiral Strauss to consider which of the various possible means of sweeping the mines would afford the greatest safety to the men on the ships. As a result of the recommendations of the board, it was decided that the first operation should be experimental, using a very short sweep and sweeping transversely across the lines of mines with the hope that the sweepers might always be between the lines (which were 500 yards apart) when there was a possibility of the sweep wire being in contact with the mines in any individual row. In this way it was hoped that the danger due to countermining might be largely avoided.

Considerable work had to be done before the first operation could be undertaken. The sweeping material had been brought over by the sweepers in bulk and required to be distributed and assembled before leaving port. Many repairs had also been necessitated by the trans-Atlantic voyage.

While these preparations were in progress a disturbance occurred in Inverness between the United States bluejackets and the local population. It was the only occurrence of its kind which marred a sojourn of approximately two years of the United States forces in Scotland. The riot had been brewing for a long time and revolved essentially around the old, old question of the feminine contingent. Our men with their higher pay and possibly greater attractions had captivated the Scotch lassies to such an extent that the native sons, upon demobilization, found their contemplated brides enamored with the foreigners. The feeling grew steadily worse, even though every means to prevent an open brawl was used. Athletics were encouraged to the fullest possible extent with the hope of attracting the majority

of the men to diversions in which the girl question would not arise. But, regardless of the precautions which were taken, the crisis was reached on the evening of April 25, when the demobilized soldiers and sailors, coupled with a portion of the male population, rose *en masse* and drove the American bluejackets off the streets. Liberty was stopped at once and remained suspended during the remainder of the period that Base 18 was kept in operation. The whole affair was probably regretted far more by the citizens of Inverness than by our own men. The shopkeepers especially deplored the sad occurrence, since a very high percentage of their profits (and a very good profit it was) resulted from the trade with the American sailors. Later it was humorously interesting on Sunday afternoons to see the line of "bonny lassies" holding hands through the barbed-wire fence which separated them from their American "laddies" within the confines at Base 18.

Two days later the Secretary of the Navy and his party, who were then making an inspection tour of Great Britain, passed through Inverness on their way south. On account of the limited time available, Base 18 was not inspected.

By the 28th of April everything was in readiness to commence the first operation, but sailing was delayed for 24 hours on account of the heaviest snowstorm of the year. The following morning the 12 sweepers which had arrived, accompanied by 6 sub chasers, got underway for the barrage, while the *Black Hawk* and the remaining chasers sailed for their new base at Kirkwall. A few hours after the *Black Hawk* had anchored she was joined by the *Heron*, *Auk*, *Sanderling*, and *Oriole*, just arriving from the United States.

Since the first operation was to be purely experimental, no definite area of mines was to be cleared. Several important appliances were still to be tested, and on account of the scant experiments which had been possible to perform prior to the arrival of the sweepers, it was desired to gain more definite information of the behavior of the mines. We must know more definitely the danger of countermining; what percentage of the mines were still in place; and if the mines were still in the positions in which they had originally been laid. There was a possibility that the storms and currents had scattered them from the straight lines in which they had been dropped, in which case the safety reasons for adopting the method of sweeping which had been chosen for this first operation were groundless.

In passing it will be noticed that these and subsequent experiments were a loss of time and a serious and wasteful delay of a large force that could have been avoided could the four sweepers requested in December, or even the *Sonoma* and *Ontario*, have been obtained for this very purpose of developing the safest and most efficient sweep and determining the characteristics of the field.

The pairs of sweepers were directed to stand over to a point on the southern side of the barrage opposite buoy No. 6, form line abreast, well separated, so that the mines which were countermined by one pair would not be likely to damage adjacent pairs, then sweep across the barrage toward buoy No. 6. After completing the first crossing they were to turn and recross back and forth for two days to gain the information required.

On May 2 the sweepers and sub chasers completed the first operation and proceeded to Kirkwall. In all 221 American mines had been destroyed, which represented approximately 25 per cent of the total mines which were laid in the areas over which they had swept. The percentage at the time seemed much too small, and in the light of subsequent operations was easily accounted for on account of the difficulty which the sweepers had in telling when their sweep was broken. It frequently occurred that a pair of vessels would continue operating for sometimes hours before they became aware that their sweep had been severed by the explosion of a mine. In this manner they assumed that there were no mines in the areas which they had passed over, while in reality the mines were still there but could not be caught with a broken sweep.

The principal appliance to be tested was the use of an electrically charged sweep wire by which it was hoped to blow up the mines when the sweep wire came in contact with their mooring cables as well as with their antennæ. In order to charge the sweep a more or less elaborate arrangement was necessary on board the sweepers which insulated the kite wire from electrical contact with any part of the vessel and connected it through the sweep drum to the proper side of the generator. Special insulated kite wire had been manufactured in the United States for this purpose.

The device was not, however, successful, due to several unforeseen factors. The first and most serious was the effect upon the magnetic compasses of the ships; the powerful solenoid caused by the current in the kite wire which was wound around the sweeping drum caused a deviation of the magnetic compasses amounting, in some cases to nearly eight points. Various ships were differently affected, and in consequence steered widely diverging courses in attempting to make parallel crossings over the barrage. While the larger portion of this deviation could possibly have been eliminated, the scheme was still unsuccessful, for it was found in later experiments that the electrical charge was dissipated so rapidly from its point of connection with the uninsulated wire that no effect was produced a few fathoms from the connection.

In addition to this, the insulation of the kite wire was unsatisfactory. The conductivity of the steel wire was so low that the insulation heated excessively, becoming in some cases so soft as to almost

allow it to be wiped off from the wire. Besides this, the heavy pressure on the insulation as it was hauled in over the roller chock on the stern of the sweeper caused it to crack so badly that its insulating properties were much impaired almost as soon as it had been placed in use. The principle of using the charged sweep was therefore abandoned.

During the two days there had been observed seven separate instances of countermining, none of which had resulted in any damage to the vessels engaged. The thing learned which was of greatest importance in the subsequent operations was that the countermines were apt to occur at any time without relation to the initial explosions which caused them. The cause of these "hang fires" was not entirely apparent. It might be due to leaks started in the antenna floats which, after reaching a certain point, were sufficient to explode the mines. Observations at night on the hydrophones showed that the mines continued exploding throughout the night at irregular intervals. Admiral Strauss therefore decided that since mines were apt to explode at any moment without relation to other mines, the safest method of sweeping the barrage would be to cross the field the minimum number of times that was actually necessary; or, in other words, to use the largest sweep which it was practicable to employ instead of endeavoring to use a sweep, as had been done on the first operation, sufficiently small to allow the sweepers to be between the lines of mines when there was a possibility of exploding a mine by contact with the sweep wire. The longer sweep would allow a field to be cleared in about one-third as many crossings over the mines as would be necessary with the shorter one.

Since no information was available relative to the size of the sweep which could be employed and kept at a uniform depth without the use of buoys, it was again necessary to undertake experiments. On account of the large number of exploding mines, which meant frequent sweep partings, it was out of the question to attempt to use buoys on the sweep wire to keep it at uniform depth, since such practice would make a cumbersome sweep requiring much loss of time for passing and repassing. On the other hand, the sweep must be sufficiently short to prevent it from dragging along the bottom, which would frequently result in breaking it. It was necessary that the kites should reach a depth of at least 250 feet and it was equally necessary that the cod of the sweep should not, in general, go below a depth of 300 feet.

As a result of the two days' sweeping, it was apparent that the 18 minesweepers which had been assigned to the mine force could not hope to complete the clearance of the barrage that year, so Admiral Strauss requested that 16 more be dispatched to Kirkwall at the earliest possible moment, 4 to be sent immediately they could be

made ready without waiting for docking or protective devices, as this installation could be installed on that number by the *Black Hawk* using spares then on hand; the other 12 to be fitted in United States yards before sailing.

It was further apparent that additional vessels would be required to act as mark boats for the sweepers to enable them to navigate more accurately. It was understood that some of the New England deep-sea trawlers had been taken over by the Navy during the war for patrol vessels and Admiral Strauss asked that 30 of these be sent him for work in the North Sea. A few days later, however, it was learned that the Admiralty would be glad to turn over on charter any number of their new steam trawlers which we might require, provided we could furnish crews to man them. Since this arrangement was quickest, permission was obtained from the Navy Department to take over 20 of these vessels and place American crews on board.

During the two days' sweeping, the loss of sweep wire and kites had been heavy, although not nearly so heavy as we were later to experience. It was apparent that our estimates had been far too light. The original quantity we had ordered was therefore doubled, and arrangements were made to obtain as many kites as possible from the British Admiralty, while more could be built and sent us from the United States.

The day after the sweepers returned to port our first casualty occurred. William McHaskell, boatswain's mate first class, while operating the towing engine of the *Auk*, was caught between the shaft of the sweeping drums and the crosshead of the engine and badly crushed. He died shortly afterwards. As a result of the recommendations of a court of inquiry, all sweepers were required to install safety guards to prevent similar accidents occurring.

CHAPTER IV.

THE SECOND MINESWEEPING OPERATION.

While the vessels were in port being overhauled experiments were conducted to ascertain the largest sweep which it would be practicable to use in the barrage. Since no special recorders for measuring the depth at which the kites and sweep wire rode, it was necessary to use an improvised arrangement in order to obtain an approximation of the data required. As a result of the test, it appeared feasible to sweep at approximately 800 yards distance, using 600 fathoms of sweep wire and 90 fathoms of kite wire on each vessel.

In the meantime the preparations for taking over and manning the British trawlers were arranged and Lieut. Commander E. N. Parker, United States Navy Reserve Force, and Lieut. T. D. Warner, United States Navy, were sent to Falmouth, where 11 of these vessels were placed in commission with the assistance of the U. S. S. *Chattanooga* and the British authorities. Lieut. Commander Parker and the *Chattanooga* later proceeded to Grimsby, England, where the nine remaining trawlers were turned over to the United States Government and commissioned before sailing for Kirkwall. Considerable difficulty was encountered in obtaining personnel to man these vessels. Orders had just been received to begin the release of the men who had enlisted for the duration of the war. The mine force was already ^{at} undermanned, as well as most of the other European stations, and officers and men were consequently at a premium.

Considerable difficulty was encountered during the first part of the operations in making the necessary repairs on the minesweepers. Many of them were sent over with practically no spare parts, which necessitated making patterns and castings on board the repair ship before many of the repairs could be completed.

By the time the repairs and overhaul of the minesweepers and subchasers had been completed a southeastly storm came on, which lasted several days and prevented the vessels from sailing until the 10th of May.

This coming operation was to be the first real attempt to clear a definite area of the mines. It had been decided to clear each of the 13 groups of mines separately, since the first operation had shown that the mines were closely within the charted positions and that to sweep the large intervening spaces would therefore be a loss of time. Countermining was still considered our greatest danger. Therefore,

in order to reduce its possible effects while we were learning more about the mines, it was decided to sweep group 12 on the coming operation, since only one of its three rows of mines were laid at the very dangerous upper level. As a further safety precaution all pairs of sweepers were to sweep transversely; that is, to cross the lines of mines at right angles to their length, then turn and recross, overlapping their last track. The method is tedious and slow, but it was deemed to be safer since the possibility of being above a mine when others might explode was considered less. The 9 pairs of sweepers which were available were to work independently, separated by equal intervals along the length of the field, in order that the countermines caused by one pair would be less likely to affect neighboring ships.

As our trawlers had not yet arrived at Kirkwall, the British Mine Clearance Officer there, Commander C. H. G. Benson, Royal Navy, kindly lent us 8 trawlers under his command, which were then unemployed, to act as marker boats for the sweepers.

The second day on the field started the casualties, which continued intermittently throughout the operations. Curiously, too, the cause of most of the serious mishaps came from a totally unexpected source. Up to this time the danger of mines fouled in the kites, exploding when the sweep was being hauled in, had not been experienced.

The *Patuxent* was the first victim. On May 12 the sweep had been severed by an explosion and had to be hauled on board to be repaired. When the kite was within sight a mine could be seen hanging by its mooring cable. The commanding officer immediately sent all hands forward to a place of safety, going aft himself to clear it with the assistance of his chief boatswain's mate. The mine was on the surface about 10 feet from the side of the ship when suddenly, without apparent cause, it exploded. Several men were blown overboard by the mass of flying water, but all were rescued. The commanding officer, who at the time of the explosion was only a few feet from the mine, escaped with the loss of his thumb, which was amputated by a flying fragment. Since the force of the explosion had been largely spent in the air, the damage to the ship was not serious, and a few days in dry dock were sufficient to repair her.

Up to this time several mines which had fouled the sweep had been hauled on board as souvenirs; for, according to design, they should be safe when within approximately 30 feet of the surface. This practice now was discontinued voluntarily. No one trusted the mines under any circumstances, and one ship even went so far as to double the risk by throwing one, which was then on board, back over the side.

Precaution, however, could not entirely eliminate the danger of mines fouled in the sweep. In the first place, they could not be seen until they were dangerously close to the ship; then the action which

was taken might or might not prove the proper one. It was impossible to tell.

Two days after the *Patuxent's* accident the same casualty befell the *Bobolink*, but with far more serious results. Again the commanding officer went aft to clear the mine in person. Almost before anything could be done it exploded, killed the commanding officer, Lieut. Frank Bruce, United States Navy, and blew the boatswain and three other men into the water. All four were rescued, although the boatswain had been knocked unconscious by the shock.

The ship was seriously damaged. The after hull plating had been driven in in places as much as 2 and 3 feet; the rudder and rudder post were gone; the propeller distorted and shaft bent; the engine had been thrown out of line; the towing engine, capstan, searchlights, and many other fixtures had been broken or disabled. The boilers, fortunately, were not damaged, which enabled the wrecking pumps to handle the water which poured into the after part of the ship.

The *Teal* took the *Bobolink* in tow and, accompanied by the *Swallow* and *SC-45*, headed for port. Before they had progressed far a heavy fog set in, which added to their difficulties. In passing Fair Isle, which was invisible in the fog, they found themselves to northward of their position. The *Swallow*, which was leading, grazed a submerged rock but signaled the danger warning to the *Teal* and *Bobolink* in time for them to alter course and avoid it.

Later the same day the ships attempted to enter Scapa Flow, their destination, via Kirk Sound, which had been blocked except for one narrow and difficult opening during the war to bar the passage to the enemy's submarines. In the strong tide which runs in the passage the towline to the *Bobolink* snapped and the current was rapidly setting her on shore. The *Swallow* managed to get alongside her and make fast before the tide had carried her into dangerous water. As they continued up the gradually narrowing channel the *Teal*, which was leading, realizing that the *Swallow* with a ship in tow would be taking too great a risk in attempting this passage, signaled to the *Swallow* to turn around. In attempting to turn they were set into shallow water by the 8-knot current and forced to anchor. The anchor dragged and the *Swallow* grounded, but was able to get off at once without assistance. Leaks were started in nine of the fuel-oil tanks, which necessitated docking the *Swallow*.

After temporary repairs were made to the *Bobolink* at Scapa she was towed to Devonport, England, where extensive repairs were undertaken. Special parts, such as rudder, rudder post, and stern tube were shipped from the United States to Devonport to save time, but even then it required over six months to complete the repairs.

On the 16th of May a middle level mine was countermined directly beneath the *Turkey*, causing her to leak so badly as to necessitate docking.

It was a fortunate thing for us to have drydocks so near at hand as those at Invergordon and at Lyness in Scapa Flow. Almost daily ships were being damaged so badly that they required docking. The British, to whom the dry docks belonged, gave us permission to use them as the occasion arose. Toward the latter part of the operations, however, the conditions at Lyness were somewhat altered on account of the large amount of dry dock work necessitated by the salvaging of the sunken German ships, and the freedom which had hitherto been granted us to use this dock became somewhat restricted.

The long hours of daylight which existed during the summer months in that high latitude were of great assistance in our operations, since they enabled the vessels to operate up to the limit of physical endurance and were further beneficial, especially during the early operations, because they enabled the vessels more easily to keep clear of the many floating mines which had broken adrift in the vicinity of the barrage. It is interesting to note that although far fewer British mines were laid in the barrage than American mines, a great many more of the former type were sighted afloat than our own. While ours were a menace to the sweepers at night, the British mines were very much more so, since the electric protective device was ineffective against them. As regards the supposed safety of mines broken from their moorings and floating on the surface, Admiralty records showed that previous to the summer of 1918 four vessels had been sunk by mines broken adrift and floating on the surface. On account of the danger of floating mines, all ships were directed not to cruise during the hours of darkness unless it became absolutely necessary.

The usual nighttime procedure when the weather permitted was to steam several miles from the mine field and anchor by means of a heavy weight or a kedge anchor made fast to the end of the sweep wire. When there was no wind such an arrangement was usually sufficient to hold the ships, but even a moderate breeze ordinarily caused them to drag considerably.

The seagoing qualities of the sweepers and also subchasers was not fully appreciated during the early operations, and as a result the ships sometimes sought shelter during storms in which they could have operated as they later did.

While proceeding to Lerwick in the Shetland Islands for shelter on the night of May 22, the *Osprey*, the flagship of the senior officer present, ran aground on Loofa Baa in Lerwick Harbor. The little harbor was rather congested with shipping, which obscured several of the aids to navigation and particularly one marking the obstruc-

tion on which the vessel grounded. By lightening the ship as much as possible she was cleared the following day and proceeded under her own power to Kirkwall and later to Scapa, where she was docked. The damage done in grounding was slight.

By the 29th of May the operation was completed and all vessels returned to port. The clearance of group 12 had required considerably longer than had been expected. After each of the pairs had completed sweeping its own section, numerous longitudinal sweeps were required with all the vessels in formation before no mines were found. The fleet, too, had been materially reduced by the casualties which had occurred and which had accordingly lengthened the time required to complete the operation. A total number of 1,672 mines were accounted for, which indicated that 43 per cent were still in place. This figure was almost double what we had been led to expect as a result of the first sweeping operation.

Next to the casualties to the ships and their personnel the most serious factor was the heavy loss of sweeping material. Sweeps had parted over 200 times, resulting in the loss of approximately 50 kites and huge quantities of sweep wire. A few days after the operation had begun Admiral Strauss cabled to the Navy Department requesting that his order for 30 kites per month be increased to 150 kites per month, and that the first deliveries should be made in June. From then on the problem of providing sufficient gear for the vessels to continue sweeping necessitated combing the dockyards and supply bases of Great Britain, and even searching the coast of France, in hopes that material of the nature we required might be found.

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CHAPTER V.

THE THIRD MINESWEEPING OPERATION.

From the beginning the insulated kite wire had been a source of considerable annoyance. Under the heavy pressure the insulation split and peeled off as the kite wire passed over the stern chocks of the ships. Manila rope would have served equally as well as the insulated wire, since it was not found possible to use the charged sweep originally contemplated, but manila was particularly difficult to obtain in Great Britain.

With the hope of finding some solution to enable bare kite wire to be used, Dr. H. L. Curtis, of the Bureau of Standards, who was then in London, was sent to Kirkwall in order that his technical experience might be utilized. Experiments were carried out under various conditions to ascertain the possibility of extending the zone of electrical protection down the kite wire a sufficient distance so that mines touching it would not explode until they had passed beyond the distance at which damage to the ship might result. The results of the experiment were interesting but not productive. No matter what arrangements were used, the electrical charge was dissipated within a few feet of its point of application to the kite wire, and the only solution that remained was to cover the steel kite wire with some nonconductive insulation which would prevent it from firing the mines. The old insulated wire was patched up, parceled and served; ships which had sufficient manila used it; and those with neither took plain wire and insulated it with a heavy parceling of canvas served over with marline.

Trouble was encountered with the boilers on several vessels on account of the bitumastic coating in the feed-water bottoms becoming loose and being carried into the boilers, thence through the steam lines to the engines. On account of this condition several vessels—the *Auk* and the *Curlew* in particular—were disabled at various times for periods of several days while the bitumastic was being cleaned out.

The problem of providing sufficient water for the sweepers became acute immediately after the completion of the second operation. The rainfall, upon which the water supply was largely dependent, had been light. Without warning the town authorities announced that the water supply for our ships was no longer available. Although the sweepers were designed to have evaporators of sufficient capacity to make them independent in so far as water was concerned, it proved to be far from the case. The evaporators could not produce half

their rated capacity, and at the end of 16 days all vessels had returned to port practically empty of water. Admiral Strauss investigated the possibility of obtaining water from a small fresh-water lake about 5 miles from Kirkwall, but aside from the high charges which the owner demanded for the water, which in the meantime was running to waste, the development work would have required considerable time and expense. Arrangements were therefore made to send out water boats to Lyness, a distance of approximately 50 miles, to refill. By keeping the water boat working constantly and by exercising the strictest economy it was possible to keep the vessels supplied in this manner.

By June 2 all of the trawlers which we had taken over had arrived at Kirkwall and were being fitted out for their intended duties on the mine field. The U. S. S. *Seneca*, which had also been ordered to join the mine force on account of her excellent facilities as a wrecking ship, arrived at this time. That vessel, however, belonged to the Coast Guard, and as they requested that she be returned to the United States at the earliest possible date, she was detached from the mine force about a week after she had arrived.

The incidental work in connection with the sweeping had by this time increased to such an extent that it became necessary to establish a small base on shore where the large quantities of sweeping material buoys, etc., might be stowed, repaired and assembled. Arrangements were completed through the British Admiralty to take over a small tract of land at Carness Point, on the eastern side of Kirkwall Harbor for this purpose. The space had previously been occupied by three fishing industries and contained small sheds which were available for barracks. Additional barracks, however, were brought from Base 18 and set up here, and this, together with a loading pier for trawlers and sweepers constructed by the *Black Hawk*, satisfactorily met our requirements throughout the summer.

Considerable anxiety had been felt from the beginning whether or not the electric protective device would cause an undue amount of electrolysis on the hulls of the sweepers. The heavy electric currents flowing from the hulls of the ships might possibly cause the steel plating and fixtures to deteriorate so rapidly as to seriously affect the structural strength of the vessels. As fast as the ships were docked for repairs necessitated by injuries on the mine field they were carefully inspected to ascertain the rate of the corrosion. At first it appeared perhaps more serious than it actually was. Wherever there was a bare spot on the hulls the pitting could easily be seen, but although it was quick to take effect, the subsequent rate was not sufficiently fast to seriously weaken the shells of the vessels.

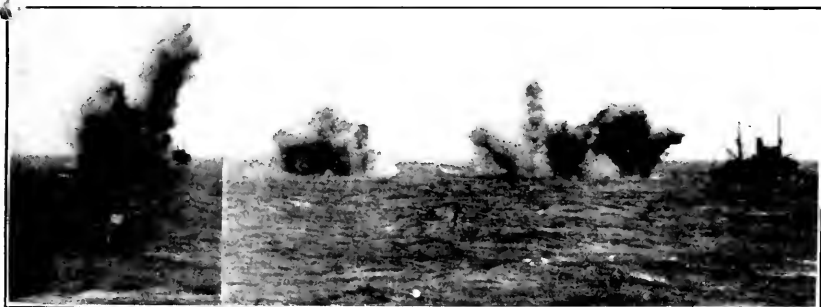
By this time so much of the incoming gear required for the mine sweeping had accumulated at Inverness that it was necessary to send



Sinking a mine by rifle fire. (Page 18.)



Sinking a mine by rifle fire.
(Page 18.)



Three explosions between the Lapwing and Penguin. (Page 40.)

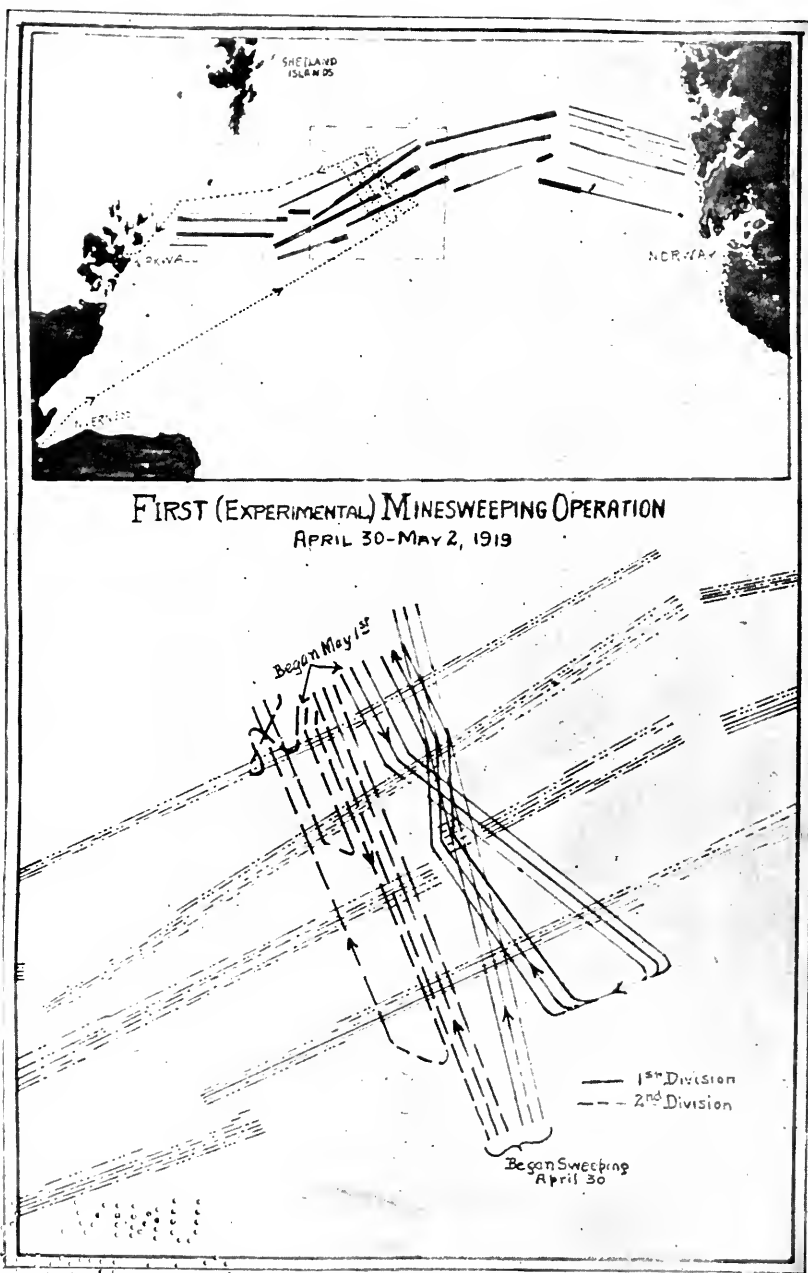
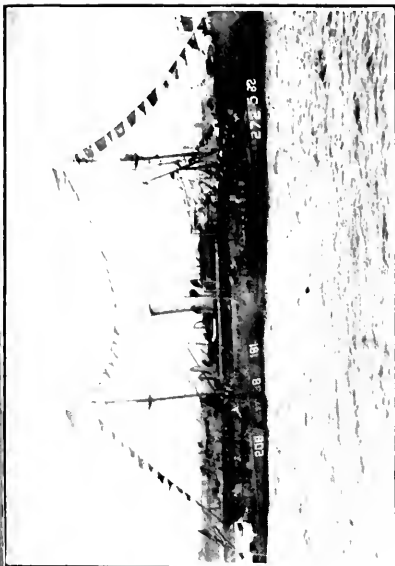


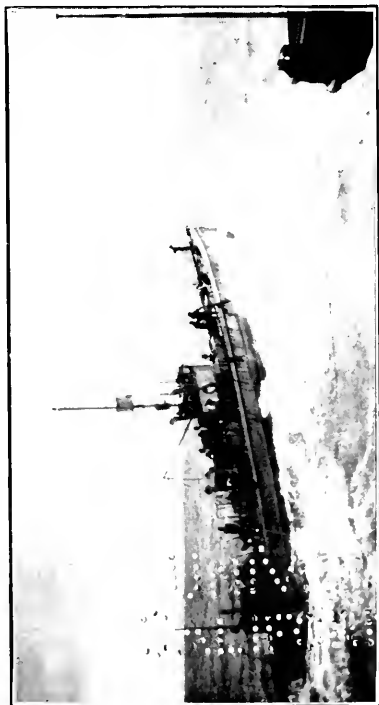
Chart showing first (experimental) mine sweeping operation, April 30, 1919-May 2, 1919.
(Page 22.)



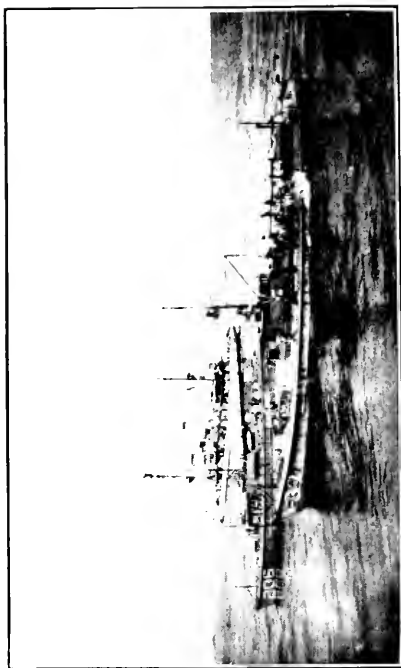
Sub chasers, trawlers, and sweepers tied alongside repair ship. (Page 26.)



U. S. S. Panther, mother ship to submarine chasers and trawlers, dressed for the Fourth of July. (Page 39.)



Submarine chasers proved to be capable and seaworthy boats. (Page 29.)



Sub chasers and a mine sweeper.



A mine foul of the U. S. S. Patuxent's kite. The mine exploded in less than a minute after this picture was taken. (Page 27.)



A complete mine recovered during sweeping operations. T. N. T. lying on the deck. (Page 27.)

the *Aspenleaf*, the British oil ship operating under our orders, to Inverness to transport the gear to Kirkwall. During the spring, while the preliminary arrangements were being made for the arrival of the sweepers, considerable difficulty had been encountered in obtaining a gasoline boat large enough to care for the sub chasers throughout the operations. Up until the last moment none could be allotted to our use, and it had been necessary to have shipped to Inverness a large amount of gasoline in drums which were then on hand at the United States air station at Eastleigh, England. Also a large number of dan buoys, which had been requested, had arrived at Inverness. It was this gasoline and other material that the *Aspenleaf* brought from Inverness and stowed aboard until such time as it was required elsewhere.

During the first part of June the ration allowance for the sweepers and trawlers was increased \$1 a day. This was done at the request of the Commander of the Mine Force on account of the unusually long hours which the men on the mine field were working, which necessitated giving them an extra meal after their regular supper. This allowance had previously been authorized for the sub chasers.

On account of the difficulty of seeing marker buoys which were planted by the various vessels to define the limits of their work, an effort was made to obtain a number of small captive balloons which might be tethered to the buoys in order to increase their visibility. Twenty of these were obtained through the British air ministry, and arrangements were begun to fit the trawler *Richard Bulkeley* as a balloon ship in order that she might fill the balloons with hydrogen and secure them to the buoys as required. The scheme, however, could never be carried out on account of the poor construction of the balloons. The bags were made of single-ply fabric and when filled would not retain their buoyancy for more than a few hours. We required a balloon which would stay up at least four or five days.

By the 3d of June the sweepers and chasers were again ready to sail, but a storm delayed their departure until the afternoon of the 5th. The same day they sailed four of the new sweepers, the *Chewink*, *Flamingo*, *Thrush*, and *Penguin*, which had been requested by the admiral upon completion of the first operation, arrived at Kirkwall, and the *Black Hawk* began at once the installation of the electrical protective devices which had been sent over on the first sweepers for spares.

Group 9 was to be cleared on the third operation. This group, consisting of 5,520 mines, was the largest which had been laid on a single operation. The British had already cleared their single line of mines laid at a depth of 95 feet about 1,000 yards to the northward of our field. Out of the 1,300 British mines originally laid

in this line 606 had survived until summer and were accounted for by the British sweepers.

The object in clearing this large group at the present time was twofold. On future operations it would shorten the distance that our vessels would have to steam in going back and forth from port and at the same time would reduce the number of mines which might break adrift and menace our ships in the western part of the barrage. Furthermore, this group of mines, although the largest we had laid, contained only two rows laid at the upper level. It was still desired to avoid as much as possible the chances of being damaged by counter-mining while experience was being gained. This danger was not, however, so great as had been originally anticipated, and Admiral Strauss had therefore decided to have one division of the mine sweepers sweep their section of the field longitudinally in order to compare this method with the transverse sweeping which had been used up until this time. If the division succeeded in demonstrating that the danger was no greater, our sweeping speed could probably be greatly increased and possibly enough to complete the clearance of the barrage this year. In order to judge personally the relative merits of the two methods, the admiral hoisted his flag on the *Eider* and spent several days on the mine field observing the actual conditions and the difficulties which were being encountered.

An interesting indication of the success of the barrage occurred the second day after the sweepers had begun work. In the western part of the barrage the water is more shoal than elsewhere, and while crossing the lines of mines the *Heron* and *Sanderling* were suddenly brought almost to a standstill by an obstruction which fouled their sweep. A few minutes later a large patch of oil rose to the surface and spread out astern of them. Evidently a German submarine which had been sunk in the barrage had been encountered. The minelaying squadron while passing close to the same spot a few days after they had laid the mines had sighted the body of a German sailor floating in the water. From the records of the Admiralty, it was presumed that the obstruction was the wreck of the German submarine *UB-127*.

A few days after the operation had begun the admiral returned to port. From what he had seen he was convinced that longitudinal sweeping could be used with equal safety. The rate of sweeping of the division which had tried it out had been no faster than that of the other two divisions, but the cause was apparent; in the first sweeping of a line of mines the division, three pairs in tandem, could keep position on this line by the explosions and the mines cut adrift. But after having once gone over such a line and having removed the greater portion of the mines, much difficulty was encountered in locating the position of the line so that the remaining mines could be removed. If it were possible to accurately define the lines of mines with buoys

preliminary to the sweeping operations, it could reasonably be expected that a field could be cleared in a very much shorter period of time. Some doubt existed whether such buoying could be carried out successfully on account of the difficulty of telling exactly the position of the lines of mines due to the irregularity in which they exploded and rose to the surface. At least it was worth a try, and orders at once were issued to fit out a buoy-laying squadron in order to have the fields which were to be cleared on the succeeding operation marked before the operation began.

With each field carefully buoyed on each side throughout its length, a formation sufficiently large to cover the entire width was desired to sweep longitudinally in one formation. For such a formation more vessels were required. The only ships available were the British trawlers which we had recently taken over. They had been built expressly for minesweeping and, although it was impossible to fit them with the electrical protective device, it was considered feasible to use them in the rear of the regular sweepers to cover the ground which had once been swept over and thus catch any mines which might have been missed in the initial sweep. Preparations were begun at once to fit out 10 of these vessels and have them ready for sweeping by the time that group 9 was completed.

As soon as the *Osprey* had completed her docking, necessitated by the grounding in Lerwick Harbor, detailed experiments were made to obtain accurate data with regard to the performance of the sweep wire and kites. Sweeps were parting continuously, sometimes without apparent cause, and since it was oftentimes attributed to fouling the bottom instead of being severed by the explosions of the mines, it was necessary to know exactly at what depth the kites and sweep wire submerged under various conditions. Special depth recorders had been borrowed from the Admiralty, designed expressly for measurements of this nature. They consisted of small torpedo-shaped flasks containing hydrostats for measuring the pressures, which were recorded continuously on sheets revolved by special air clocks which were not affected by the heavy vibrations in the sweep wire. With these depth recorders it was possible to make accurate measurements which enabled us to determine exactly the lengths of kite wire which must be used under various conditions.

The problem of providing sufficient sweep wire became extremely serious before group 9 could be completed. We had practically drained the Admiralty of all they could spare; a small quantity then on hand at the manufacturers had been purchased and still the supply was insufficient. When the trawlers were being taken over at Grimsby, Lieut. Commander Parker had noticed a considerable stock of sweep wire in the naval base at that place, but in response to a telegram to the senior naval officer of that port we were informed that none could

be spared. Lieut. Commander Parker was, however, certain that if he were permitted to go in person he would be able to obtain at least part of the quantity which he had seen. The Commander of the Mine Force, as a last resort, even though he had been refused officially, gave Lieut. Commander Parker permission to take a trawler to Grimsby in hopes that some of the wire might be procured. A few days later the trawler returned with 11,000 fathoms of wire. This quantity was barely sufficient to tide us over until the first shipment from the United States arrived at Liverpool.

On the 21st day of June the tranquillity of existence in the isolated little village of Kirkwall was broken by the news that the interned German fleet at Scapa Flow was being scuttled by the men on board. Admiral Strauss's report to the Secretary of the Navy is particularly interesting and is quoted in full:

I have to report the sinking of the interned German fleet at Scapa Flow to-day. At about 12.30 I received word from Commander White, Royal Navy, senior naval officer at Kirkwall, that at noon a German ship had sunk, and simultaneously the German colors had been hoisted on all of their ships. No information reached me from Admiral Prendergast, commanding the Orkneys and Shetlands, who was, at the time, the senior British naval officer in the vicinity. Vice Admiral Sir Sydney Fremantle, commanding the Fifth Battle Squadron (now the guard squadron in Scapa), was absent exercising at target practice in Pentland Firth. Commander White came on board shortly after 1 o'clock and announced that several more German ships had been sunk. I at once went ashore, taking Capt. Bulmer with me, and proceeded by automobile to Houton Bay, the nearest point on the mainland from which the German fleet could be seen. On coming within sight of the anchorage of the German fleet it was evident that most of them had disappeared. It was then 3 p. m., and at about 3.10 p. m., upon arrival at Houton, I gave orders by telephone for all minesweeping tugs of our force at Kirkwall to proceed at once to Scapa Flow and report to Admiral Prendergast for duty. I thought it possible that some of the sinking vessels might survive long enough to be towed into shoal water. It is about 40 miles from Kirkwall Bay to the German fleet's anchorage. I notified Admiral Prendergast by telephone that these vessels would be under his orders. At a few minutes after 3 o'clock four of the minesweeping tugs were under way for Scapa.

At 3 o'clock the Fifth Battle Squadron had returned from sea, but two of the ships were still under way at 3.30. The others had anchored apparently in their regular berths. Shortly afterwards all of the squadron had been anchored. At 3.30 there were but three German battleships afloat, one north of and close to Cava Island. This ship was being towed along in a westerly direction by a British destroyer with the evident intention of beaching her on the Calf of Cava. She was deep in the water with a slight list to port. Another battleship was anchored north of the land joining Scad Head and Green Head. This vessel was also deep in the water and listed slightly. A little later her moorings had evidently been slipped and she was drifting with the ebb tide to the southward and eastward. The battleship *Baden* was anchored about half a mile north of Scad Head, apparently uninjured. Two light cruisers, one of the *Emden* class, were under tow by a destroyer each north of the Barrel of Butter. They were being towed toward Smoo groo Bay. A light cruiser of the new *Emden* class was at anchor between Green Head and Cava and was evidently filling rapidly by the stern. This last ship sank in a few minutes while at anchor. She submerged slowly by the stern until her forefoot was well out of the water, when she keeled over on her starboard side and sank. The next ship to sink was the battleship which was

drifting between Scad Head and Green Head. She was well down by the stern when she turned with head southwest, righted herself, and sank on an even keel with the top of her turrets just awash. At about 4.20 the destroyer towing the battleship northeast of Cava parted her towline. Her tow was then deep in the water but upright. In a few minutes she listed heavily to port, then turned completely over on her port side and sank. At about 4.30 one of the light cruisers had been beached in Smoogroo Bay. She is in an upright position with the water just below her upper air ports. She can be salvaged. At this time they were still attempting to tow the light cruiser of the *Emden* class into the same water. As this vessel still had nearly all of her freeboard they have probably succeeded.

The *Baden* is the only heavy ship afloat at this writing. As far as could be seen from our point of observation at Houton, all of the large number of destroyers in Gutter Sound were sunk. One light cruiser had been beached on the western side of Cava Island.

At 5.30 I received a message from Admiral Prendergast to recall the four tugs, as they were no longer needed.

I was told by an officer of the British air force at Houton that he had seen 16 of the German vessels sink. The first one, Admiral Von Reuter's flagship the *Emden*, having sunk almost exactly at noon. He stated that all of the vessels had the German colors flying when they sank. None that I saw sink had them hoisted. He stated that the colors on the remaining vessels had been hauled down on the approach of British destroyers. I was also informed that Admiral Von Reuter came ashore in a British drifter before his flagship sank. He was carefully dressed, and the enlisted men with him, seen by my informant, were in clean dress blues. He had his baggage with him, but at once requested of the British officer in command at Houton Bay that he send off vessels to save the crews, exclaiming that his men were sinking the ships. Admiral Von Reuter was not permitted to land but was sent off in the drifter to the British station ship *Imperieuse*. The crews of the various vessels were rescued by British trawlers and torpedo vessels. I have no information as to casualties.

The sweeping of group 9 dragged on to what seemed at the time an interminable period. The weather during the month of June had been bad—far worse than the ordinary—and this, coupled with the heavy currents which flow through the Fair Island passage, had greatly delayed the completion of the operation. On the 1st of July, after 26½ days at sea, the group was finally completed and the sweepers returned to port. Of this time 11 days had been lost due to inability to operate on account of the storms. The damages had been light; none of the vessels had been seriously injured except *SC-164* and *SC-208*. The former had been damaged by a mine which she was sinking exploding near her on the surface, causing considerable wreckage about the upper decks. *SC-208* after sinking a mine had steamed past it and it had exploded after having sunk some distance below the surface. The seams in her hull were opened up so that she was taking considerable water and had to be escorted to port by the *Teal* and another chaser. Docking was required before she could resume operations. Several of the ships had had narrow escapes but in each case, with the exception of the *Tanager* which required a week in port, were able to complete the repairs upon the mine field.

A report had been received from the Allied Naval Armistice Commission, who had been carrying out the armistice inspections in Germany containing the details of the German methods of mine-sweeping. In general they employed very small vessels for sweeping and used neither serrated wire nor any form of cutter to cut the mooring cables of the mines when encountered in the sweep. Nothing could be learned from their methods.

It was some consolation to know that our progress was more rapid than the British sweeping forces who were engaged in clearing their portions of the barrage. One of these forces was based at Kirkwall and was responsible for clearing the British mines in the western half of the barrage. The other was based at Lervig, in Norway, and was engaged in removing British mines adjacent to the Norwegian coast.

Our rate of sweeping although better than the British was far from satisfactory to us. Unless it was *tripled* it would be impossible to complete the clearance of the barrage during the summer of 1919. The Commander of the United States Naval Forces in European Waters had already shown signs of uneasiness and had asked for an estimate of the date on which the sweeping would be completed. The Commander of the Mine Force in turn replied that no estimate could be given until after the completion of the succeeding operation. By that time the new method of sweeping longitudinally with all ships in formation, after having carefully buoyed the mine field in advance, would have been tried and he could then estimate how much longer would be required to clear the 11 remaining groups.

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CHAPTER VI.

THE FOURTH MINESWEEPING OPERATION.

One day after the sweepers returned to port the buoy-laying squadron set out to mark the small group 12-A and then group 11, which were to be undertaken on the fourth operation.

Fortunately, the overhaul period between the third and fourth operations enabled the mine force to celebrate the Fourth of July. Although the major items of repairs could not be suspended under any conditions, it was possible to lay aside many of the routine duties in order that the majority of the men in the force could engage in the customary celebrations without delaying the sweeping operations. Boat races, field sports, baseball games, and various entertainments, including a large smoker in Kirkwall in the evening, were arranged and made the day most pleasant. The British entered cordially into the festivities, as they had done on the preceding Fourth of July in Inverness.

By the 7th the sweepers were again ready to go out. The buoy-laying squadron had succeeded in marking the small group "12-A" and were well along with group 11. The task had not proved so difficult as had been expected. The steel antenna floats of the lower and middle level mines enabled them to be distinguished from the upper-level mines when they were cut adrift. By noting the interval of time which elapsed between the explosion of a mine and the appearance of the slick on the surface it was generally possible to determine whether it had been planted at 160 feet or 240 feet. The upper-level mines were more difficult to identify. If they exploded it was usually after they had been dragged some distance from their position; when they were cut up a certain allowance, dependent on the depth of the water, must be made for the amount that they had dipped while being sawed from their moorings. Countermines were frequent and were of much assistance, since they rose exactly in the position in which they had been laid. The currents in the North Sea were baffling. None of the hydrographic publications gave definite data as to their strength and directions, and measurements had to be taken constantly in order that a proper allowance might be made.

Details of the formation and the method of sweeping were worked out with great care for this operation. Three pairs of sweepers were

placed in column formation on the lower and middle level lines of mines. There were insufficient vessels to have three pairs on each of the upper-level lines of mines, and it was perhaps not so necessary, since fewer of them were still in place. It was hoped that by this arrangement at least one pair on each line could always be kept operating while the others repaired their sweeps after having parted them and were regaining their positions in the formation. This compact formation also assisted navigation and made it much easier to keep on the lines while proceeding from one buoy to the next (the buoys were 3 miles apart).

Shortly after noon on the 7th of July the sweepers arrived at the western end of group 12-A, took their respective positions in the formation, and started down the field. Seven sweeps of this field were made with the entire formation, before no mines were found. This was done in a day and a half, or with twice the rapidity of the previous operation. But here a large percentage of time was necessarily lost due to frequent turnings, for, in fact, only 7 hours and 40 minutes of actual sweeping had been required on this small field, and besides the gain in time, it was satisfying to know, thanks to the buoys, that all parts of the field were covered each time.

The *Oriole* and *Rail* had been damaged by mines fouling their kites and exploding as they were hauled in, but besides this, which was apt to occur irrespective of the method of sweeping, no casualties had marred the inauguration of this new plan. The enthusiasm of the force was unbounded. At last definite satisfactory results for the effort expended could be seen.

Before the vessels could get straightened out and started on the next field, group 11, the oncoming darkness made it impracticable to attempt further operations that evening. The next morning, July 9, the 43 vessels were in formation and headed down the mine field.

But a flood of catastrophies was in store for us, more than we should have to face any other day during the entire operations. The first victim was the *Curlew*, which was damaged by the explosion of a mine fouled in her kite and was forced to return to Kirkwall for repairs. Shortly afterwards three mines were countermined beneath the *Patapsco*. Fortunately, the damage was not serious. The *Penguin* followed with numerous minor damages from an explosion in her kite, and almost at the same time the *William Darnold* was similarly disabled. Both ships succeeded in making temporary repairs upon the mine field and continued operations. The *Lapwing* was next; she was seriously countermined and had to return to port. Sub chaser 46, while sinking a floating mine, exploded it and also had to return. Then, to cap the climax, six mines were countermined beneath or close aboard the *Pelican*. One directly beneath her was an upper-level mine and the ship was practically deluged in the mass of water

thrown up by the explosion. When the water had subsided the *Pelican* was sinking. The explosion had badly ruptured the forward part of the ship and she was rapidly filling with water.

Just 17 minutes after the accident Capt. R. C. Bulmer, who had come out to direct the operations, had placed his flagship, the *Auk*, alongside the *Pelican*, connected the wrecking hose with the forward compartments of the damaged vessel, and the pumps were working at their maximum capacity to keep the ship afloat. A few minutes later the *Eider* had secured on the *Pelican's* other side and her pumps were doing likewise. The *Teal* then took the three ships in tow and the four vessels, lashed together, headed slowly for port, with the bow of the *Pelican* barely above water. All went well for the first few hours. The pumps of the two vessels were sufficient to maintain the *Pelican* in her present condition. Her own boilers had been disabled by the explosion, so that she was entirely dependent upon the assistance of the *Auk* and the *Eider*. But they had not gone far before difficulties began to arise. A head sea sprang up which made it difficult for the vessels to remain alongside of the *Pelican* without excessive strain being thrown on the moorings and hose lines as the ships were tossed about by the seas. As the ships proceeded conditions grew worse. The pump lines carried away and the water gained rapidly until the *Pelican's* bow was awash. The forward fireroom bulkhead, which alone kept the *Pelican* afloat, was buckled and distorted by the pressure of the water on the forward side and in danger of bursting at any moment. Since under such conditions it was not safe to leave unnecessary men aboard the damaged ship, 12 volunteers to remain on the *Pelican* to do the necessary work were asked for, but every member of her crew stepped forward. After choosing the 12 strongest men, the remainder had to be ordered from their ship against their will.

In the meantime, the crews on the *Auk* and the *Eider* worked desperately to get the pump lines repaired and again operating. There were still 50 miles of open sea to be traversed before shelter could be reached, and to add to the difficulties darkness had overtaken them. Men stood by with axes to cut the mooring lines on the *Auk* and the *Eider* in case the *Pelican* should sink. This struggle continued throughout the night, and although it seemed at times as if there was little hope of reaching shelter where the pumps would have a better chance and where some leaks might be plugged, the ceaseless and determined efforts were finally rewarded when, the following day, the ships reached the shelter of Tresness Bay with the *Pelican* still afloat. Such holes as could be plugged with the vessel in her present conditions were stopped, and the same afternoon

she was towed to Scapa Flow, where she was docked and temporary repairs made to enable her to be towed to Newcastle-on-Tyne, where complete repairs could be undertaken.

In order to expedite these repairs, since the dry dock was in great demand at this time for salvage work on German destroyers, 25 carpenter's mates and shipwrights were taken from the *Black Hawk* and *Panther* and, with a repair officer, sent in a trawler, where they were quartered to work as a night shift on the *Pelican*. The damages, however, were so extensive that three weeks' continuous work was required before her hull could be patched by wooden timbers sufficiently well to permit her being again towed in the open sea.

The morning following the day on which so many of the vessels suffered casualties a curious accident befell the *Flamingo*. She had anchored for the night a few miles to the northward of the mine field, but on account of the current and wind had dragged until at daylight she found herself considerably to the southward of her original position. While weighing the anchor, which had become fouled with a mine while being dragged through the mine field, steel touched copper and the mine went off close under her stern. The rudder was badly damaged, the skeg was bent, capstan and generators disabled, and the stern dished in in several places. It was necessary to tow her to Kirkwall, and later to Invergordon, where she was dry docked.

The most serious casualty of all occurred on the 12th of July, when the trawler *Richard Bulkeley* was sunk by the explosion of a mine fouled in her kite. It had been sighted a few feet below the surface of the water, and in an attempt to reduce the danger the kite wire was being veered in order to get the mine farther astern. For some unaccountable reason it exploded, shattering the after part of the hull, allowing the ship to fill and sink within seven minutes.

The vessels in the vicinity rushed to her assistance, but before they could arrive she had gone down. They managed, however, to recover all but one officer and six men, who either drowned or were carried down with their ship.

The commanding officer, Commander Frank R. King, United States Navy, who was also in command of the division of trawlers, had last been seen on the bridge as the ship settled lower and lower in the water. Previously, when one man had struggled to the deck half stunned by the shock of the explosion which had blown off his life preserver, Commander King took off his lifebelt, buckled it around the sailor, and helped him to get clear of the ship before she took her final plunge. Until the ship disappeared he was still hunting for others of his crew who might be left on board. He went down with the *Richard Bulkeley* and was never seen again. In commemoration

of the memory of this gallant officer the Secretary of the Navy a few months later named a new destroyer in his honor.

On the 17th of July the sweeping of group 11 had been completed. Two days had been lost on account of the weather, making a total of six days which were required to clear this field, which had originally consisted of nearly 5,500 mines. From the viewpoint of time, the results had been everything which we had hoped for and the rate of sweeping had actually been tripled. With good weather conditions there seemed now a chance of completing the clearance of the barrage before the winter storms set in, but since only two more favorable months remained this was still highly improbable.

On the other hand, the casualties had been enormous. One vessel had been sunk, another permanently disabled, three damaged so badly that dry docking was necessary, and several others, less severely damaged, had been able to make temporary repairs on the mine field which enabled them to continue. A careful analysis of the accidents, however, showed that in the greater portion of the cases, they had been due to causes which were independent of the method of sweeping, and since we were working at a much faster rate, the accidents had only been proportional to the number of mines which were being swept per day. It was therefore decided that the present method of longitudinal sweeping should be continued, since the total accidents would be the same in either case and the preference lay decidedly in favor of the more rapid method.

One lesson had been learned. The structure of the trawlers was not sufficiently strong to withstand the shock of the exploding mines. Although they had been used for sweeping astern of the other vessels to make sure that the field was clear, they had accounted for a far larger number of mines than had been expected. The danger, therefore, would constantly exist, so the admiral decided to return the majority of them to the Admiralty, keeping only six which were to be used for miscellaneous purposes, transporting stores from Inverness to Kirkwall and carrying minesweeping gear and provisions to the vessels on the mine field.

When the trawlers had been taken over from the Admiralty they were accepted on the assumption that they were in first-class operating condition. The formality of an on-charter survey was waived, and it was likewise agreed that when the vessels were returned they should be turned over in the same condition and that no off-charter survey should be called for. The monthly rates of hire which we were paying for the trawlers were as follows: Mersey class, £240 per month; Castle class, £225 per month; Strath class, £160 per month. In case of loss or serious damage, the United States should be responsible for the liabilities incurred.

As soon as it was decided to return part of the trawlers all possible repairs which could be made were undertaken by the repair ships. A few days later the vessels were dispatched to Brightlingsea, England, where they were turned over to the British Admiralty with the assistance of the U.S.S. *Chattanooga* who represented the Commander of the United States Naval Forces in European Waters. It is of interest to note that the British officers who accepted the trawlers for their Government were delighted with the condition in which they were received; so much so in fact, that they remarked they had never seen trawlers in such perfect condition.

The additional sweepers which Admiral Strauss had requested in May had, in the meantime, arrived. Four reached Kirkwall on the 10th of July and four more on the 15th, making a total of 12 instead of the 16 which were originally requested. This now brought the total force of sweepers up to 32, 2 of which were permanently disabled and 3 more either in dry dock or about to go in dry dock for repairs.

CHAPTER VII.

THE FIFTH MINESWEEPING OPERATION.

With the exception of one minor change, the method of sweeping which had been used on the fourth operation was to be continued until the barrage was cleared. The buoy-laying squadron, after completing its work, had carried out experiments to ascertain the practicability of removing the greater portion of the lower and middle level mines by exploding them by touching their antenna. The object sought was to reduce the losses of kites and sweep wire. Much difficulty was still being encountered in obtaining sufficient quantities of this material to keep the sweepers supplied. When attempting to cut a mine from its mooring the mooring frequently slid along the sweep wire until the horns on the mine case came in contact with the sweep wire and caused the mine to explode. The sweep wire was almost invariably shattered by such an explosion, and aside from the delay necessitated in repairing and repassing the sweep, parts of the gear were frequently lost before it could be hauled aboard.

The experiment was in all respects successful. Over 75 per cent of the mines at the deeper levels were exploded in this manner without damage to the sweep. It was accordingly decided that on subsequent operations the leading pair of sweepers on each row of deep mines should have their sweeps regulated so as to touch the antennas instead of cutting the mooring cables. The two pairs of sweepers which followed the leading pair were to set their sweeps well below the depth at which the mines were planted so as to cut up any mines which were defective or had lost their antennæ and were not exploded. So few of the upper level mines still had antennæ left that it was not worth while to attempt a similar method on them, and it was therefore necessary to continue sweeping them by cutting the mooring cables as had been done up to this time.

A scheme which partially solved the danger of mines fouling the kites was adopted at this time and consisted of placing explosive cutters on the kite wires just above the kites. Then, when the mooring lines of mines slid down the kite wire they would be caught in the jaws of the cutters, operate the mechanism, and be chopped in two before they had an opportunity of fouling the kite. These cutters lessened the danger of mines fouling the kites approximately 50 per cent.

We had at last found a satisfactory method for sweeping the barrage and one which would enable us to complete the work in a few

months. In the meantime, however, we had been laboring strenuously, but under great disadvantages. We had begun work with immature knowledge on various points and many experiments had been necessary. These experiments, which have been mentioned previously, consisted of several to determine the present condition of the mines separately and as a whole; two to determine the depth to which sweep wire could be submerged; one to determine the maximum practicable spread of the sweep; and several others in an effort to use the charged sweep. Besides this, the first three operations had been undertaken and executed with this imperfect knowledge, with the result that too much time had necessarily been spent on an apparently small percentage of our task. Also, we had had to discard the charged sweep, the installation for which had been costly both in time and money.

These delays were what we had hoped to avoid when, during the previous winter, we had requested four sweepers; then, when this request was refused, had asked for the *Sonoma* and *Ontario*. The delays that continually threatened, due to failures in the delivery of sweep wire and kites, and the additional work entailed in parceling out our small supply and exchanging articles between sweepers on the mine field, are mentioned elsewhere. We had requested sweepers at Inverness by April 1, but it was the 20th before the first ones arrived, and although we had asked for at least 18, and more if they could be spared, only 18 were sent, and it was the 7th of May before the last 2 of these reported. Then, on May 2, when we asked for 16 more sweepers, only 12 were sent.

At this time, in reply to our cable stating the improbability of finishing this year, a message was received from the department saying;

Department notes possibility unable complete minesweeping this summer and urges most strongly that every possible effort be made to complete this work this year.

And two weeks later a second, stating in part:

Department insists that sweeping must be completed this year and will cooperate in every way to accomplish this.

It was naturally rather disheartening to realize from these two messages that the department failed to appreciate the difficulties under which we were working and that every possible effort was being made with the facilities available to speed this work to the limit. However, despite the difficulties, the task was completed with all the dispatch the department hoped for.

In the early days of preparation for the sweeping operations it had been feared that the problem of adequate signal communications with so large a force of small vessels with comparatively untrained crews, would offer many difficulties. When the sweepers would be in formation they would stretch out over a distance of more than 10 miles and the ordinary visual signals would conse-

quently be out of the question without a considerable loss of time and possibility of error in relaying the messages. With this in view, it had been requested that the sweepers be fitted out with radiotelephone installations. The subchasers, which had been engaged in submarine patrols in European waters, had already been supplied with this equipment.

The various procedures for communications had been carefully worked out and incorporated in the Minesweeping Orders which had been printed and issued to the force prior to the first operation. In general, all messages which could be transmitted without relaying were to be sent by flag hoist, searchlight, or semaphore. Messages which affected a division, squadron, or the entire force were sent by radiotelephone. Shape signals, consisting of combinations of balls, drums, diamonds, and flags, were also prescribed for the more common signals in connection with passing sweeps and maneuvering. On the whole, the system was highly satisfactory, and after the first few days no difficulties were encountered. The radiotelephone proved highly reliable as well as possessing a high degree of ruggedness, and in only the very severest of accidents was disabled by the explosion of mines. The range of audibility of the telephones for the mine sweepers averaged approximately 30 miles. In some cases satisfactory communication was maintained at distances of 50 to 60 miles. On account of the short antenna of the subchasers their range of audibility was considerably less, in general, not being more than 10 miles. Considerable difficulty was constantly encountered on the subchasers on account of the salt-water spray and leaks in their hulls, which caused a great amount of short circuiting in the apparatus. The spark sets on the sweepers, though only 1 kilowatt, proved entirely satisfactory, especially after all sweepers were equipped with audion panels and the flagships with two step amplifiers. Communication between the *Black Hawk* and sweepers at anchor in a Norwegian Fjord, 250 miles distant, was carried on with ease.

The *Eider* and *Flamingo* were dry docked at Invergordon during the latter part of July and both carefully examined for the corrosive effects caused by the currents in the electric protective device. Approximately 30 per cent of the rivet heads and about 15 per cent of the plates showed considerable pitting. The zincs were completely eaten away. The condition, however, was not serious nor progressing at a rate which was likely to prove serious, provided that the operations were completed within a reasonable period.

About this time an interesting memorandum was received from Dr. H. L. Curtis, of the Bureau of Standards, who had visited the mine force at Kirkwall a few months prior in connection with experiments in insulating the kite wire. Assuming that a current of 100 amperes was used on the electrical protective device, the electrolytic action

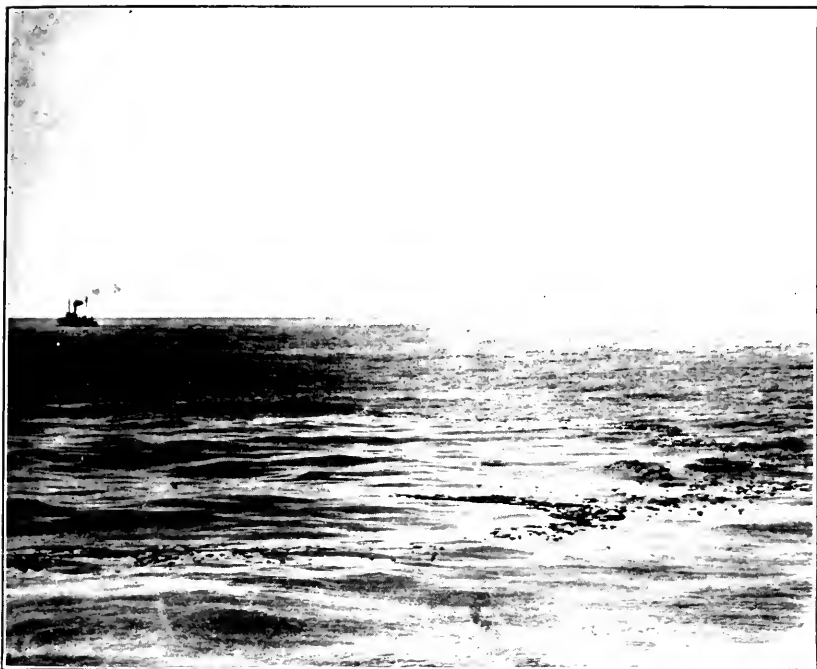
resulting therefrom would cause the loss of approximately 100 grams of iron per hour from the hull of the ship. This would amount to about 1 ton per year, provided that the current flowed continuously, which was, of course, not the case. Since this loss, if concentrated in a few unpainted spots, might prove serious by weakening the strength of the skin of the ship, it was desirable that the hull should not be kept too thoroughly painted, for then the deterioration would be more evenly distributed over the skin of the ship.

The sweepers sailed again for the mine field on July 22, after having had a period in port of only four days. The buoy-laying squadron had by that time practically completed the marking of group 6 and then group 3, which were to be undertaken on this operation.

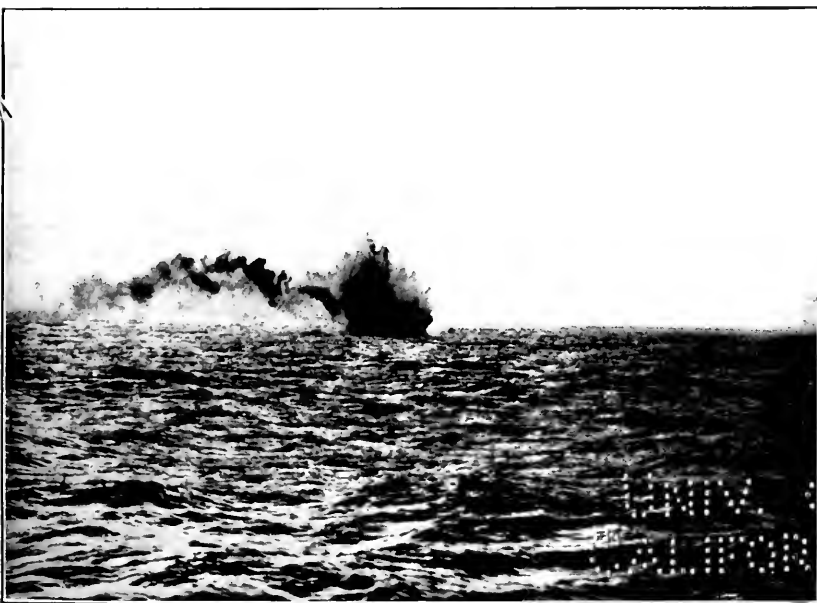
While buoying group 6 a very interesting condition was discovered. On account of the pressure of time when the barrage was being laid it had been necessary to assume that the soundings given on the charts were approximately correct. Since none of the soundings, except near the Norwegian coast, were greater than 80 fathoms, the mine moorings had all been cut to this length so that they might be used in any portion of the barrage except the deep along the coast of Norway.

During the minelaying no opportunity had been available for checking the soundings, and even if it had been, little could have been done to alter the material which was then on hand. During the buoy-laying operations, however, careful soundings were taken at intervals of approximately 3 miles along each of the groups of mines, and it was found that in the sixth group the depth of water for over half its length was well over 80 fathoms, in one place reaching a depth of 125 fathoms. This meant that the mines when planted were carried to a depth considerably below that intended on account of the limitations in the length of their mooring cables. The result was that for over half the length of this group there was in reality no surface barrage at all. Fortunately, the water shoaled to the northward, so that groups 9 and 12 were planted in less than 80 fathoms, which prevented the break in the surface barrage from extending throughout its width. This same condition was discovered later to obtain also on the Norwegian end of the barrage, causing group 2 to be planted deeper than intended.

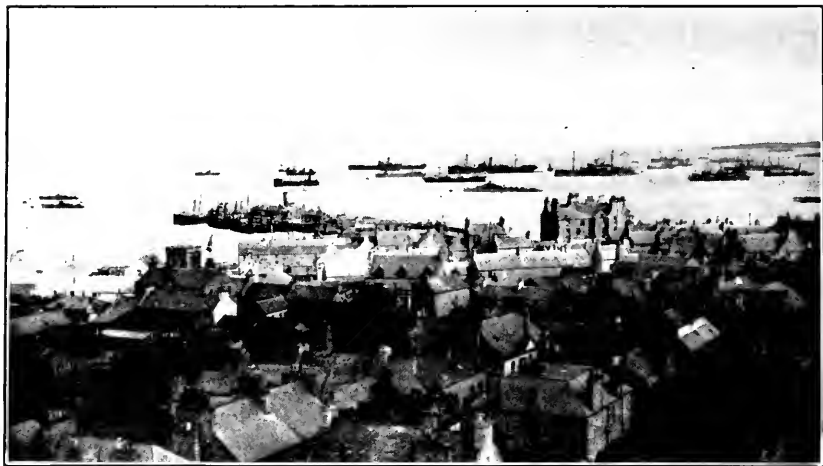
The new method of antenna sweeping for the lower and middle level mines proved highly successful. Group 3 was completed in two days. Before group 6 could be completed a storm had overtaken the fleet, making it impossible to work and carrying away most of the marker buoys which had been planted. The buoy squadron, which had, in the meantime, returned to port, was rushed out to repair the damage done by the storm and also to mark groups 5, 5-A and 7, so that these groups might be undertaken before the ships



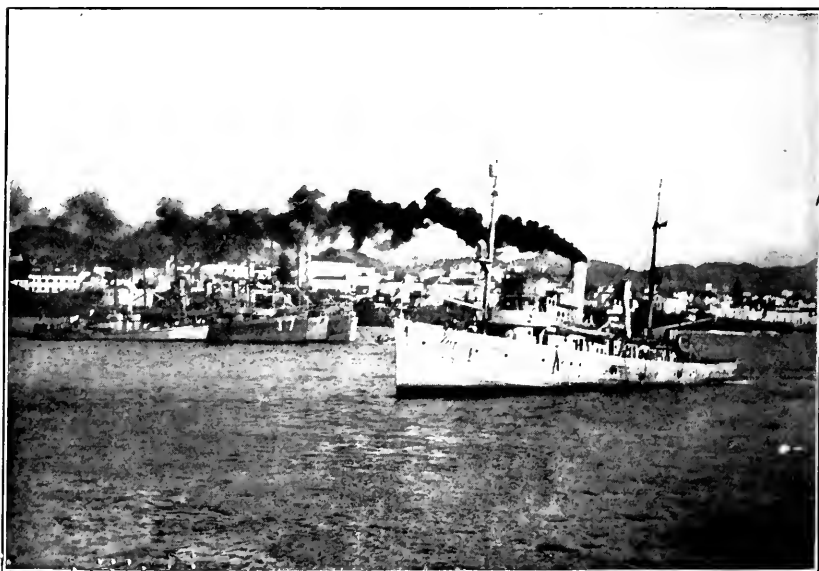
Explosion of deepest level mine. A circle of brown discolored water spreading slowly around the vessel. (Page 18.)



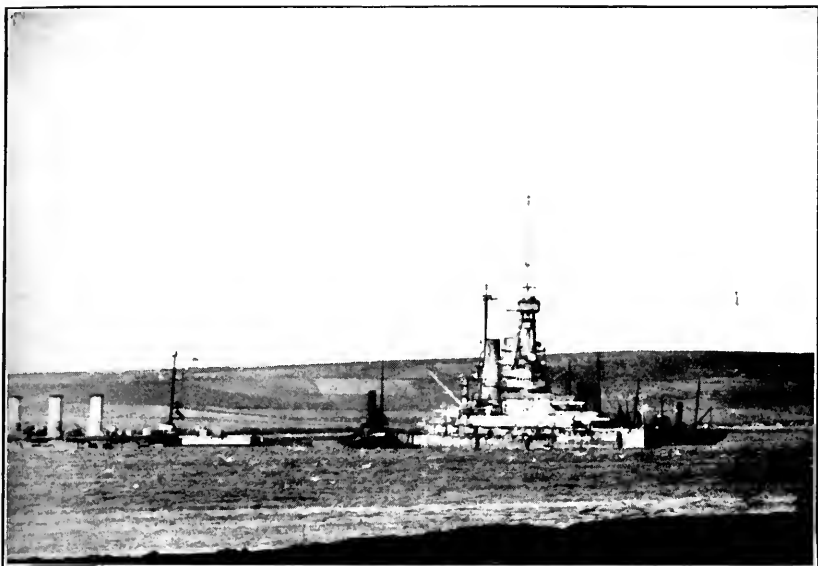
U. S. S. Bobolink in the midst of a mine explosion. Completely destroyed May 20, 1919. The vessel's smoke can be seen emerging from the left of the explosion. (Page 28.)



Kirkwall Harbor, Orkney Islands. U. S. mine sweepers at sea. (Page 19.)



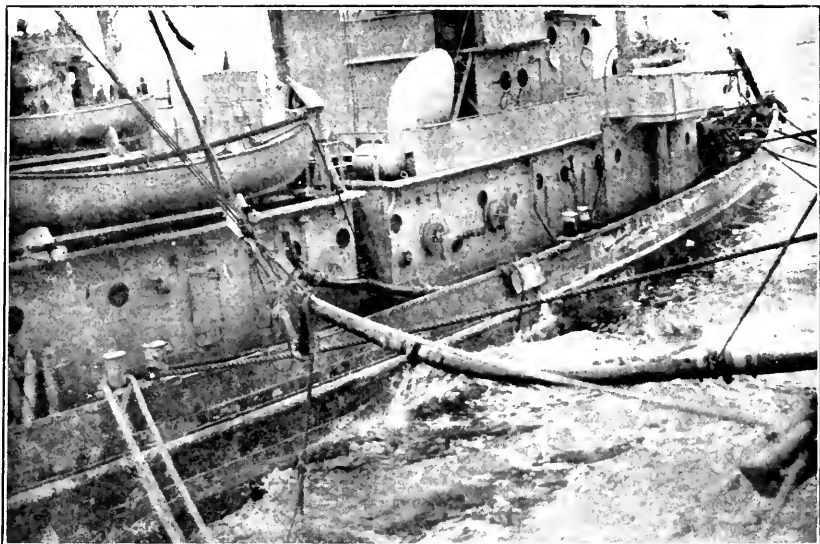
The mine sweeping fleet at Stavanger, Norway. (Page 56.)



A portion of the German high-seas fleet which sank in shallow water at Scapa Flow.
(Page 36.)



The mine sweeping detachment at Ponta Delgada. (Page 71.)



U. S. S. Pelican shortly after she was countermined, showing the pump line from U. S. S. Eider keeping the Pelican afloat. (Page 41.)



Transferring material at sea.

DIAGRAM OF THE SWEEPING FORMATION

SWEEPING A SINGLE LINE OF MINES

The leading pair of Sweepers leave their sweep regulated to cut the mines not exploded by the leading pair following astern of the Sweepers is a Sub-Chaser engaged in striking by cut the mines not exploded by the leading pair. The Sweepers can be seen the explosion of a mine when it has been encountered by the shock of the mine fired by touching the sweep wire.

Fig-51

Chart showing diagram of the sweeping formation and sweeping a single line of mines. (Page 45.)

DETAILS OF SWEEP USED IN CLEARING THE NORTH SEA BARRAGE

Distance Between Sweepers = 750 yds

A. Collier, Electrician of
Electric Protective
Device.

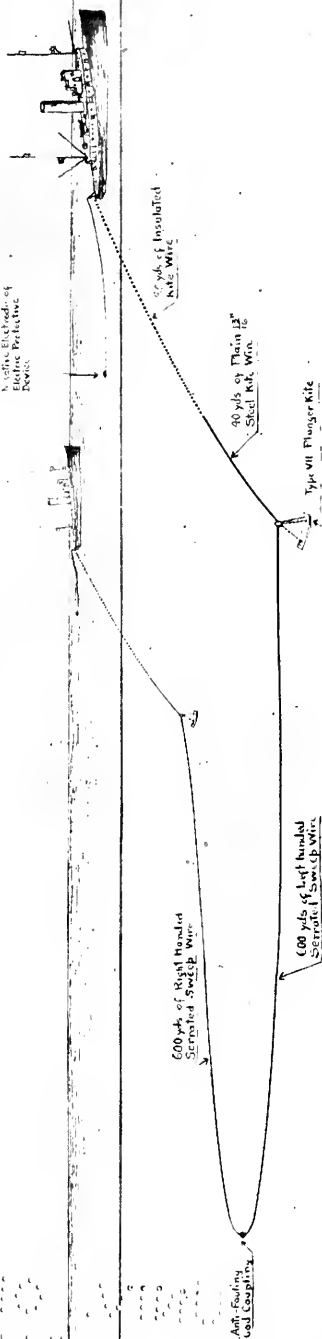


Fig-10

Chart showing details of sweep used in clearing the North Sea barrage. (Page 45.)

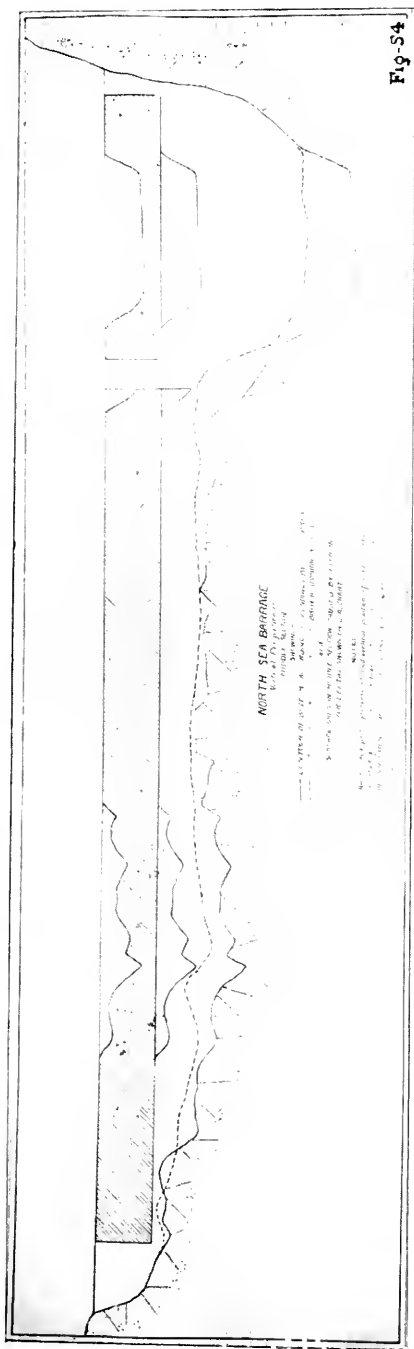


Fig-54

Chart, vertical projection of middle section, North Sea barrage, showing contour of bottom according to soundings by U. S. S. Osprey and by British Admiralty chart. (Page 48.)



Sphero-cylindrical steel buoys stowed at Carness Point. These buoys were used for marker buoys for the mine fields. (Page 68.)



A deckload of marker buoys and dan buoys. The long slender spars with a barrel in the middle are called dan buoys. (Page 68.)

NO. 1000
SUBMARINE

returned to port. The rate of sweeping had been so rapid that the ships had requested permission to undertake these additional groups before returning to Kirkwall. Five working days sufficed for the clearance of group 3. Groups 5 and 5-A, which had a combined length of less than 20 miles, were cleared in a single day and group 7 was begun at once.

Considerable fog caused intermittent delay in the operations, but in spite of this group 7 was completed in three days, after which the fleet returned to port August 7. The western end of group 7 had not been cleared on account of the danger of the British line of mines, which started a few miles to the northward. These mines had been planted only 6 feet below the surface, and since their relative position was not accurately known it was not considered safe to approach their general vicinity.

The damages incurred during this operation were remarkably light. The *Auk* on July 30 was countermined and forced to return to Kirkwall for three days' repairs. The *Osprey*, the flagship of the buoy-laying squadron, while laying a dan buoy found it fouled by a mine which exploded beneath her bow, causing much minor damages but not preventing her continuing the operation. Sub chaser 208 was again injured by the explosion of a mine which she had sunk but was able to make port under her own power. The auxiliary condensers on the *Turkey* had exploded due to bitumastic being carried over from her double bottoms and lodging under the valves of the condenser, preventing their closing, and allowing the steam pressure to build up to such a point as to wreck the condenser. She was able to continue, however, until a condenser was taken from the *Pelican*, which was permanently disabled, and installed on the *Turkey*. A mine exploded in the kite of the *Curlew*, blowing two men overboard, one of whom sank almost immediately and was not recovered. The vessel continued sweeping throughout the day, but later was ordered to Kirkwall to have the leaks stopped which had been caused by the explosion.

Two more instances of the success of the mine barrage were encountered during this operation when wrecks of vessels, presumably submarines, were encountered by the sweep wires. The two obstructions were comparatively close together, one in latitude $59^{\circ} 20' 30''$ north, longitude $0^{\circ} 55' 00''$ east, and the other in latitude $59^{\circ} 29' 30''$ north, longitude $0^{\circ} 44' 00''$ east. The former was thought to be the *U-102*; the latter could not be identified from the records at the Admiralty.

The lack of sweeping material still threatened to delay us. Every conceivable source of supply was investigated; deliveries from the United States had fallen far below our expectations; the 150 kites

per month which we had requested, beginning with delivery in June, had not been received; 50 out of the first month's shipment had finally arrived with the new sweepers on the 15th of July and 50 more via fast transport. All British sources for kites had been drained, they even having resorted in some cases to the use of the prism kites in order to provide us with suitable kites to reach the great depth necessary.

Sixty thousand fathoms of sweep wire had been ordered from Bullivant Co.—a British concern—but our needs were immediate. Although we desired equal quantities of right and left hand serrated $\frac{1}{16}$ -inch wire, we were now glad to get any kind. Twenty thousand fathoms were located at Rosyth and two trawlers dispatched to bring it to Kirkwall. Shortly afterwards a supply of wire arrived at Liverpool from the United States. The U. S. S. *Chesapeake*, which had been ordered from Brest to join our forces, stopped at Liverpool en route for this, but was required to make another trip to get all the material.

The mine force had, in the meantime, been increased by the addition of three sub chasers, the *SC-95*, *SC-256*, and *SC-354* which had been on duty in Russia for several months.

On the 5th of August Capt. Roscoe C. Bulmer, United States Navy, Commander Mine Sweeping Detachment, died on board the U. S. S. *Black Hawk* from injuries received the day before when thrown from an automobile which had skidded. The death of Capt. Bulmer was a severe loss, both officially and personally, to the entire force. His unbounded enthusiasm and cheerfulness, coupled with resolute determination, at times in the face of overwhelming odds, had been invaluable in the early part of the minesweeping when the obstacles and accidents were so discouraging. His body after being embalmed was sent to Inverness and thence shipped to the United States for burial.

CHAPTER VIII.

THE SIXTH MINESWEEPING OPERATION.

Perhaps the most remarkable part of the entire sweeping operations was the magnificent spirit exhibited by the men who manned the ships. A large portion of the crews consisted of men in the Reserve Force or who had enlisted for the duration of the war. They were now due and entitled to be released from service in order that they might resume their occupations in civilian life. Orders had been issued by the Secretary of the Navy in May and June directing their release, but we could not let them go. Every man on board ship was needed, and more, too; reliefs for them could not be obtained on account of the rapidly increasing shortage of personnel in the Navy. The Secretary therefore authorized the suspension of his orders until the clearing of the barrage had been completed.

The work was dangerous and is perhaps best illustrated by a letter of Rear Admiral Strauss to the Secretary of the Navy, which read in part as follows:

We are getting along with the work much better now than at first. The weather is better and we have more ships to operate with. If the weather is extraordinarily good we may finish this year. It is quite possible, however, that the increased darkness and heavy gales that are almost continuous from the latter part of September on in the North Sea may compel us to send a small finishing expedition next spring. I am hoping that this will not be the case, and we are all bending our utmost energy to get through with it. As may be imagined, the work of gathering these thousands of mines scattered throughout an area in the North Sea of some 6,000 square miles is a big job and a hazardous one. The laying of the mines was accomplished in 50 or 60 working hours and the hazard was slight or nonexistent. We have had our losses, but are much more fortunate than the British, who lost two large minesweepers of the *Flower* class last month, when 40 men were drowned.

If we do not finish this year it will be necessary for all of the minesweepers to be distributed among our navy yards on the Atlantic coast for extensive repairs. On every trip to the mine field nearly every one of them is subjected to explosions which wreck machinery and crush plates and frames. We have 75 vessels now attached to this expedition, and the two repair ships *Black Hawk* and *Panther* serve as navy yards to keep them going. Their work is no small part of the achievement.

The men, as well as the officers, realized the necessity of completing the clearance of the barrage during the summer of 1919; they also realized that the quicker it was cleared the sooner they would be released from service, and they plugged along from 4 o'clock in the morning until 9 and 10 and sometimes even later at night. As the summer

progressed and the days became shorter, it became necessary for the sweepers to get under way and in formation in darkness, ready to begin the day's work at the first break of daylight. Frequently it was necessary to spend a good portion of the night in getting ready for the next day's work. As there never was sufficient sweep gear to equip all ships for their contemplated stay at sea, it was often necessary to transfer material from one ship whose losses had been light to another who had been less fortunate. This work was ordinarily undertaken after sweeping operations for the day had been completed. Buoys, too, for marking the new groups of mines were equally in demand. It was necessary after the sweeping of a group had been completed to pick up all the buoys which had survived so that they might be transferred to the vessels of the buoy-laying squadron and be used again. In order not to waste the hours of daylight, the buoy squadron frequently spent part or all of the night in gathering these buoys from the various sweepers who had picked them up.

It is an interesting fact that the dangers involved in an undertaking never seem to receive consideration by the average man who is required to do the work. Minesweeping was continually dangerous. Mines exploded when least expected; one ship had been sunk; on others men had been blown overboard and lost. A catastrophe was apt to happen at any moment, but by now minesweeping to all hands was merely the "day's work."

The days in port were even more busy than those at sea. Every moment had to be utilized to complete the repairs and the overhaul at the earliest possible moment. After each trip, besides refueling and taking on water, the boilers had to be cleaned, provisions obtained, new sweep gear provided, and the old overhauled and repaired. The repair ships buzzed incessantly. By this time the casualties caused by mine explosions had become so well standardized that the parts most subject to wreckage had been manufactured in quantity, so that a vessel on return to port could be fitted out immediately. At times the work in port was so strenuous that vessels were unable to grant liberty to their crews before they were required to sail again for the barrage.

A comparison of the conditions under which ours and the British forces operated is interesting. After they had completed the second operation we had 20 times as many mines to sweep as the British detachment based at Kirkwall. The forces were nearly equal in size. Their task was unquestionably a delicate one to remove the mines which were planted at a submergence of 6 feet, but then they had vessels specially constructed for the purpose, and their mines were close to port, while ours were 200 miles away. In developing a newly designed sweep for this field and in waiting for the best of weather,

their work dragged until we had cleared our entire barrage, with the exception of the southern half of the field adjacent to their single line of mines.

On account of the dangers in minesweeping the British Government employed only volunteers for this purpose, paid them almost double wages and gave them in addition a bonus for each mine that was destroyed. No recognition or extra compensation was given the American minesweepers, nor were volunteers called for to man the ships.

It was now the middle of August. After the completion of the fifth operation 55 per cent of the barrage had been removed. From a careful study of the meteorological records we could expect the equinoctial storms about the middle of September, and after that the winter storms would set in with such violence and frequency that further operations would be practically impossible. In other words, 45 per cent of the barrage remained to be cleared in approximately one month. And to make the task more difficult, of the six remaining groups, all but group 8 were in the extreme eastern part of the barrage. Group 8 began just off the Orkney Islands, but could not be undertaken until the British had completed clearing their line of 6-foot mines which ran parallel to ours and was separated by an interval of one-half mile.

The sweepers sailed to the mine field on the 12th of August. In order to reduce the distance which the sub chasers would have to steam in going back and forth to the mine field, the *Panther* and all chasers which did not accompany the sweepers sailed for Lerwick the same day to base on that port during this operation. The average distance from this port to the eastern groups was approximately 60 miles shorter than from Kirkwall. The time that the sub chasers could remain at sea was entirely dependent upon their gasoline supply, and the saving of 120 miles was equivalent to approximately an additional day with the sweepers. When the sweepers went out on an operation, and if necessary when they were returning to port, the sub chasers were taken in tow in order to conserve their fuel. In this manner the average period of 4 days, which had been the customary time which they had ordinarily stayed at sea during war-time operations, was increased in several cases to as much as 10 days.

Arrangements had previously been made with the Norwegian Government to allow our vessels to enter the ports of that country without pilots, and also to use radio within their territorial waters.

The Norwegian mine field, which had been laid in September, 1918, in the vicinity of Udsire Island, had been removed by them during the spring. After the armistice it had been learned that this field consisted of approximately 700 mines laid at a depth of 4 meters.

If the sweepers could possibly do so, the admiral desired that they should complete all of the five groups which remained in the eastern portion of the barrage before returning to Kirkwall in order to avoid the loss of time of a return trip. As our rate of sweeping had steadily increased, with fair weather conditions and light casualties, it appeared as though this might be possible.

Group 10 was the first which was undertaken. The *Tanager* was damaged by the explosion of a mine in her kite and was forced to return to Kirkwall. The *Turkey* was similarly damaged but succeeded in completing repairs on the mine field and was able to continue. In the first day's work on this field 1,373 mines were accounted for, which proved to be the record day for the barrage.

The third day after leaving port a storm prevented the ships from operating. This happened to be the date on which candidates for warrant officers were required to be examined. Predicting that the minesweepers would be at sea at this time, permission had been requested to postpone the examinations until the vessels returned to port, but the request had not been granted. In the heavy seas it was impossible to transfer the candidates to a single ship in order that the examinations might be held in the customary manner, so in order not to deprive the men of an opportunity to qualify for a commission it was necessary to appoint the commanding officers of all vessels as members of the examining board, and by means of the radiotelephone to simultaneously ask all candidates the successive questions of the examinations while they remained on board their own ships.

Despite the storm, group 10 was completed in four days. The *Penguin*, one of the vessels of the buoy-laying squadron, was injured by the explosion of a mine fouled in her kite and returned to port for three days' repairs. Group 4 was swept next and was similarly completed in four days. Group 1 was then begun, but before it was completed the sweepers were directed to shift to group 2, which consisted of only two rows of upper-level mines. These lines had proved extremely difficult to buoy on account of the small percentage of mines which remained, and it was therefore desirable to sweep it at once so as to reduce the possibility of the marker buoys being carried away in a storm and the consequent necessity of re-marking it, which, with the still fewer remaining mines, would have been doubly difficult.

After completing the initial sweep of this group the sweepers proceeded to Lervig, Norway, in order to redistribute the sweep gear, obtain fresh water, and deliver the buoys to the buoy squadron, which had been picked up after the completion of groups 10 and 4.

Lervig, which is a small summer resort about 40 miles up Bommel Fiord, was the primary base for the British minesweepers which were operating off the Norwegian coast. The harbor, though small, forms an excellent anchorage capable of berthing as many as 100 vessels the size of the minesweepers.

The sweepers arrived there on the night of the 22d, completed watering and the redistribution of gear, and sailed on the following morning. That afternoon and the next day sufficed for the clearance of group 2, but it had required more time than had been anticipated. For some unaccountable reason the mines which had been moored in approximately 150 fathoms of water seemed far more difficult to cut up, regardless of the fact that their mooring cables were only five-sixteenths inch in diameter instead of seven-sixteenths inch, which had been used on all other mines. Due to the increasing lack of kites several of the vessels substituted buoy anchors, but these were only partially satisfactory.

The shortage was extremely serious. While it was possible to clear the shallow mines by using weights as substitutes, this method could not be used on the other mine fields, where it was necessary to sink the sweeps to a depth of 260 feet. The *Black Hawk* and *Panther* had, since the beginning of the operation, laid aside other work and were now devoting all their resources to the manufacture of sufficient kites to tide over until the *Chesapeake*, which had been sent to Brest for kites arriving there from the United States, could return to Kirkwall. Fortunately, the four additional sweepers which the admiral had requested one month before arrived on the 21st and 22d of August with 30 kites on board, and shortly afterwards the *Chesapeake* arrived with 130 kites on board. The combined number were sufficient to see us through the remainder of this operation. The *Chesapeake*, however, had to return to Brest for an additional 70 kites which she had had to leave behind on the first trip.

While the vessels were operating off the Norwegian coast a disease broke out on board several of the ships which appeared at the time to be influenza. Although the ships had been at sea for a period of 10 days and it was unlikely that influenza should break out under those conditions, still it was not advisable with the frightful epidemic of the previous year still fresh in mind to take any chances. The *Chewink* and *Lark* were sent to Bergen and their patients transferred to a hospital. The ailment turned out to be Bamble fever, or what is more commonly known in Norway as fishermen's fever.

After completing group 2 work was resumed on group 1, but before the field could be completed a storm had driven the vessels into Stavanger for shelter. One day was spent in port and work was commenced on group 13. The *Rail* was damaged on the 29th by an explosion of a mine fouled in her kite, which blew one blade off her propeller and damaged the rudder so badly in addition to the customary minor breakages that it was necessary to send her to Invergordon for docking. Two days later the *Auk* was similarly damaged and also was sent to Invergordon, where she was docked at the same time as the *Rail*.

Due to fog interfering considerably with the clearance of group 13, it was the 5th of September before that group was finally completed. A mine had exploded in the kite of the *Oriole*, doing considerable damage to the after part of the ship and necessitating her return to port. The *Swan* was damaged in going alongside the *Turkey* in rough weather to obtain sweeping material and also had to return. On the 30th of September the *Seagull* was countermined by an upper level mine directly beneath her, which opened up the hull so badly as to necessitate assistance to keep her afloat.

By the 1st of September sweeping the groups of mines in the eastern portion of the barrage had been practically completed, and since no more sub chasers would have to be sent to this distant part of the field, the *Panther*, with the sub chasers at Lerwick, returned to Kirkwall.

The plans for returning to the United States had in the meantime been completed. Various possibilities for the disposal of the sub-chasers had been considered, and it had finally been decided that each chaser should be towed home by a sweeper. Since any method of returning them was very costly and their future usefulness doubtful, attempt was made by the Force Commander to dispose of them by sale, but without success.

Prior to sailing for the United States it would be necessary to dock all of the chasers in order to calk their hulls and place them in a seaworthy condition for a trans-Atlantic voyage. Arrangements had been made for this docking and repair at Devonport, England, and on the 5th of September the *Panther* and six of the chasers left

Kirkwall for that port. The dock was of sufficient size to accommodate six chasers at a time, and additional vessels were to be sent as rapidly as the repairs were completed on those then at Devonport. The *Panther* continued her duties as repair ship to the chasers, and completed such portions of the work as was possible while the vessels were in dry dock.

In the meantime the *Sanderling* had been disabled by an upper-level countermine and was laid up for the remainder of the operation. The damages were considerable, but not so extensive as to necessitate extended repairs. Sixteen days later she was able to resume operations.

The same day that the *Sanderling* was countermined a mine exploded under *SC-38*, completely disabling her. The shock had been so severe that the engine bedplates were broken, the deck lifted clear of the beams, and the hull caused to leak badly. She was towed to port by the *Heron*, but the repairs required were so extensive that the necessary expenditure was not considered justified. Unsuccessful attempts were made to sell her in Kirkwall and Inverness, after which she was towed to Harwich, and turned over to the *Chattanooga* for the same purpose.

As the work on the Norwegian side of the barrage drew to an end, it began to appear that our operations would be delayed by the failure of the British to complete the clearance of their 6-foot line of mines. Admiral Strauss had repeatedly requested the British Mine Clearance Officer to do everything possible to get their mines up at the earliest practicable date and had offered to assist him with any means at his disposal.

The sweepers after having completed the five eastern groups had requested permission to sweep group 8 before returning to port. The northern half of this field was buoyed and the primary sweep was finished, but still the British had not finished with their single line of mines. During the past few days one of the American sweepers had been operating with the British forces in order to keep them informed of the exact position of our line of mines, so that they might judge more accurately the location of their own.

The delay was extremely serious to us. Every day that our vessels were unable to operate was costing the Government between \$60,000 and \$70,000, which represents the daily operating expense of the force. More serious than this, however, was the constantly encroaching possibility that we could not finish the barrage this year. At any time now the equinoctial storms could be expected.

Since it was not safe to do further work on group 8 on account of the British mines, the sweepers, after making a preliminary test sweep of groups 5, 7, 9, and 12, returned to port, after having been away for a period of 32 days—a splendid endurance record for such small vessels.

CHAPTER IX.

THE SEVENTH AND LAST MINESWEEPING OPERATION.

On the previous operation, after the northern half of group 9 had been swept, the minesweepers still had sufficient fuel to operate for three days, so it had been decided to take advantage of the time available and make a test sweep of group 7 to make sure that all mines had been removed. This field had been less carefully swept than any of the others, and, besides, a great many more mines had been found near the western end than had been anticipated when the short end which had been left on the fourth operation was being cleared. After the final sweep had been finished on the western end of this group the minesweepers continued up the field so as to cover its entire width throughout its length. By the time they had swept 7 miles of the portion of the field which had previously been reported swept a pocket containing 24 mines was discovered. Six other mines were subsequently obtained in the near vicinity when this area was again swept. Farther up the field 4 mines were obtained in another position and 5 in another.

This condition was decidedly disconcerting. The field had been reported clear and we had had every reason to believe that it was; but now in passing over a swept field a total of 39 mines had been found. If this condition existed throughout the barrage it would be necessary to resweep each of the groups with the large number of vessels which were now available and which could be placed in formation so as to efficiently cover the full width of the field and thus eliminate the possibility of leaving holidays which were sometimes unavoidable when a small number of vessels attempted to clear a large area. The admiral had therefore directed that the remaining days which the vessels could remain at sea should be spent in testing other groups to determine whether the same conditions existed as had been found in group 7. The groups which appeared to be the least thoroughly swept were group 12, which had been swept transversely on the second operation; group 9, which had similarly been swept on the third; and group 11, which was the first field on which longitudinal sweeping was tried out.

The sweepers had started from buoy No. 6 and had steamed from there to the eastern end of group 12 then turned and covered approximately three-quarters of the length of group 11. A total of 5 mines

had been found. The next day the remainder of groups 11 and 12 had been swept and a total of 50 mines discovered concentrated in two small groups. The following day while returning to Kirkwall group 9 had been reswept and 2 mines found. The outlook was discouraging. Each of these groups had originally been swept until no mines had been obtained and they had therefore been considered clear. It was true that these were the groups in which the probability of finding mines was greatest on account of the inexperience in sweeping, and also due to the comparatively small number of vessels which were available when the groups were undertaken. But since mines had been found the admiral considered it necessary to make a general test sweep of other portions of the barrage to determine definitely the completeness of the subsequent sweeping. Time was now becoming the all-important factor. The rapidly shortening days no longer enabled the vessels to work 15 and 16 hours a day as they had done.

Thirty-two days away from port had been a long period and a hard one for the sweepers. Many repairs which ordinarily would have required the assistance of repair ships or navy yards had been completed while at sea. One sweeper had made new piston rings from a stove lid; another had dismantled her condenser overnight and replaced leaking tubes with new ones and was ready to resume operations by daylight the next morning. A third ship found it necessary to replace tubes in one of the boilers, but instead of returning to port, where she might be dismantled, she managed, by running at slightly reduced speed, to cut out that boiler, cool it down, and replace the tubes while the vessel was actually engaged in sweeping. While this was being done the ship was rolling so heavily in the seaway that her topmast had been carried away.

But there was no rest for the weary. Since it was now a question of days before bad weather would be upon us, the admiral asked by signal how many of the ships could complete their overhaul and be ready to sail at the end of three days. In less than half an hour after the signal was sent 23 of them replied that they could go. Actually 29 of them succeeded in getting away at the time prescribed, the remaining 4 sailing the following day.

The British line of mines to the southward of group 8 had in the meantime been cleared. Out of the 1,300 mines which had been laid at a submergence of 6 feet less than 50 had survived. Although it was expected that a great many had been carried away by the storms during the past year, still it was hardly believed that only such a very small number would be left.

To complete the clearance of group 8 was the principal task which remained to be done and work was begun on it immediately. But

before it could be completed the long dreaded equinoctial storms which mark the arrival of winter had arrived. For three days it raged with unprecedented violence; the sweepers at sea sought shelter in the lee of Sanday Island, while the vessels in port kept steam at the throttle ready to maneuver at an instant's notice in case their moorings were carried away. One of the lighters which was used for distributing gear to the sweepers was sunk by filling with spray, and two of the sub chasers were blown ashore, but rescued, one with some difficulty. A British transport, the *S. S. Vedic*, returning from Russia with approximately 1,000 people on board, was driven on a reef off North Ronaldsay and four of our sweepers were dispatched to her assistance. She managed, however, to float clear at high water the following day without having sustained serious damage.

By the 22d of September the storm had moderated sufficiently to enable the sweepers to resume operations. Group 8 was finished, but before the general clearance sweep could begin another storm had broken. This one lasted only one day, so that on the 24th the general test sweep was begun. The results of the next few days were waited for with almost breathless anxiety. If no mines were found our work would be complete and we could start for home at once. If, on the other hand, occasional mines were encountered throughout the field, it would be necessary to resweep each of the 13 groups in order to make absolutely sure that they were clear. The first day all went well. Group 12 was reswept and no mines were encountered; the next day another storm came on which made it impossible to work except when the ships were running before the seas, so group 5 and the eastern part of 4 were swept and again no mines were found. By nightfall the storm had increased to such an extent that sweeping was impossible throughout the following day. Realizing that the seas would still continue for nearly a day after the storm had subsided the ships headed into the storm in order to be at the western end of group 11, so that it might be swept in case the storm had moderated by the morning of the 27th. In this field there was one spot which was suspected to possibly contain several mines, although it had been covered three times, and buoys had therefore been dropped to mark the position to enable it more easily to be found on the general clearance sweep. The first time it was passed the ships were slightly out of position and no mines were obtained, but the next day it was again swept with the ships in exactly their proper position and 4 of the long-suspected mines were cut adrift. The next day groups 6 and 3 were swept and found to be free of mines. The following day, September 30, group 9 was again gone over without finding any mines and the ships slipped sweeps for the last time in the North Sea barrage.

By working the force under his command up to the limit of physical endurance, the tremendous task of removing the North Sea mine bar-

rage had barely been completed before the winter with its constant gales had overtaken us. The last week upon the mine-field, sweeping had been accomplished under great difficulties. The weather had been at its worst, but the experience of five months had enabled the vessels to operate under conditions which at first would have been hopeless. Even then they had been compelled to do nearly all the sweeping before the wind.

In the six days' sweeping 864 square miles had been carefully covered, embracing the areas which had been most densely mined and where the possibility of finding mines was greatest. In this entire area only 4 mines had been found, and they were in a position which had been suspected and buoyed in order that they might be cleared upon this final operation. It was evident that the clearance of the barrage had been complete, and the day the operations ended Admiral Strauss, in a brief message to the Secretary of the Navy, announced that the clearance of American mines in the North Sea had been finished.

The days of ceaseless effort and the lack of comforts and diversions were easily forgotten in the hour of triumph. And it was indeed a triumphant force that passed the final buoy marking the last mile of what had once been the barrage. As the sweepers, two by two, steamed by the buoy, slipped sweep, and set their course the last time for Kirkwall, cheers burst forth spontaneously from every officer and man in the detachment, while the sirens and the whistles shrieked loudly. A mammoth task had been performed; a barrier that had menaced the German submarines and later barred the commerce of the seas had finally been conquered; and the Navy's obligation to mankind to remove the mines which she had laid had been fulfilled.

A few hours after the task had been completed Admiral Strauss received the following message from the Commander of United States Naval Forces in European waters:

My hearty congratulations to you and all under your command on completion of an arduous task finely done.

KNAPP.

The next day the following cable was received from the Secretary of the Navy:

It is with the greatest of pleasure that the Secretary of the Navy congratulates the officers and men of the North Sea minesweeping detachment on having so creditably completed the stupendous task of clearing the North Sea of the mines planted by our Navy during the war. This most arduous and dangerous work, one of the greatest and most hazardous tasks undertaken by the Navy, and which has been carried on with cheerfulness and integrity, will go down in the annals of history as one of the Navy's greatest achievements. Every loyal citizen of the United States and every officer and man in the Navy must look with pride upon these men who have once again fulfilled the glorious traditions of the service which they represent.

JOSEPHUS DANIELS.

Vessels operating with mine force, North Sea minesweeping detachment.

REPAIR SHIPS AND FORCE AUXILIARIES.

Ships.	Date attached.	Date detached.	Descriptive data.	Remarks.
U. S. S. Black Hawk.	Jan. 4, 1919	Nov. 25, 1919	Displacement, 9,000; length, 420 feet; speed, 12 knots; cruising radius, 1,200 miles.	Flagship; repair and supply ship for sweepers.
U. S. S. Panther.....	May 26, 1919	.....do.....	Displacement, 3,380; length, 320 feet; speed, 12 knots; cruising radius, 5,500 miles.	Repair and supply ship for sub chasers and trawlers.
U. S. S. Seneca.....	June 2, 1919	June 5, 1919	Displacement, 1,445; length, 204 feet; draft, 17.3; speed (maximum), 13.2; beam, 34 feet.	Coast Guard cutter, intended for salvage and general utility duty.
U. S. S. Chesapeake...	Aug. 8, 1919	Oct. 1, 1919	Displacement, 1,200 tons; length, 210 feet; beam, 40 feet; draft, 13 feet; speed, 9.5 knots.	Wrecking vessel, used as cargo carrier between Liverpool, Brest, and Kirkwall.
S. S. Aspenleaf.....	Apr. 21, 1919	Aug. 18, 1919	Capacity, 6,700 tons.....	Oiler, used also as store ship for reserve supply gasoline.
S. S. Crenella.....	Aug. 16, 1919	Sept. 26, 1919	Capacity, 7,700 tons.....	Oiler.
R. F. A. Hickorol.....	May 6, 1919	Sept. 23, 1919	Capacity, 154,000 gallons.	Petrol supply ship for sub chasers and British mo'or launches.
R. F. A. Petronel.....	Apr. 29, 1919	July 29, 1919	Capacity, 370 tons.....	Seagoing water vessel.
R. F. A. Hopkilm.....	July 20, 1919	Oct. 1, 1919	Capacity, 530 tons.....	Do.

SUBMARINE CHASERS.

Ships.	Date attached.	Date detached.	Descriptive data.
U. S. S. C. 37.....	Mar. 1, 1919	Nov. 25, 1919	Displacement, 70 tons; length, 110 feet; beam, 15 feet; draft, 6.5 feet; maximum speed, 16 knots; fuel capacity, 2,350 gallons; cruising radius at 10 knots, 675 miles.
U. S. S. C. 38 ¹	Apr. 23, 1919	Oct. 1, 1919	
U. S. S. C. 40.....	Mar. 1, 1919	Nov. 25, 1919	
U. S. S. C. 44.....	Feb. 24, 1919	.....do.....
U. S. S. C. 45.....	.....do.....	.....do.....
U. S. S. C. 46.....	Feb. 26, 1919	.....do.....
U. S. S. C. 47.....	Feb. 24, 1919	.....do.....
U. S. S. C. 48.....	.....do.....	.....do.....
U. S. S. C. 95.....	July 28, 1919	.....do.....
U. S. S. C. 110.....	Apr. 12, 1919	.....do.....
U. S. S. C. 164.....	Feb. 24, 1919	.....do.....
U. S. S. C. 178.....	.....do.....	.....do.....
U. S. S. C. 181.....	.....do.....	.....do.....
U. S. S. C. 182.....	.....do.....	.....do.....
U. S. S. C. 206.....	Feb. 26, 1919	.....do.....
U. S. S. C. 207.....	.....do.....	.....do.....
U. S. S. C. 208.....	.....do.....	.....do.....
U. S. S. C. 254.....	Apr. 12, 1919	Nov. 1, 1919	
U. S. S. C. 256 ²	July 28, 1919	Nov. 25, 1919	
U. S. S. C. 259.....	Mar. 1, 1919	.....do.....
U. S. S. C. 272.....	Feb. 24, 1919	.....do.....
U. S. S. C. 329.....	.....do.....	.....do.....
U. S. S. C. 354.....	July 28, 1919	.....do.....
U. S. S. C. 356.....	Feb. 24, 1919	.....do.....

¹ Permanently disabled by mine explosion Sept. 25, 1919.² Destroyed by gasoline explosion and fire at sea Nov. 1, 1919.

July 24 to Aug. 1	3	July 15	5,395	5	5,131	{ 1@240 3@ 80 1@160 1@240 }do.....	{ C-8 A-27 B-1 C-8 }	858	1,005	118	2,041	37.9	39.9	Because of low voltage ad- justments on firing devices it is believed more than 5 per cent of this group ex- ploited prematurely. As- suming 9 per cent, the group yielded 41.7 per cent net. Total is increased by 60 mines destroyed on first operation. Total mines destroyed is in- creased by 13 mines, which were swept on the first op- eration. Total mines destroyed is in- creased by 17 mines, which were swept on the first op- eration. Western 9 miles unswept un- til sixth operation, due to danger of striking British mines laid at 6 feet submer- gence. See group 7 under sixth operation. Total mines destroyed increased by 30 mines swept on first operation.
Aug. 2 to Aug. 3	5	Aug. 9	1,506	19	1,201	{ 3@ 45 1@160 1@240 }	.....do.....	{ A-27 B-1 C-8 }	268	224	14	519	32.5	39.7
Aug. 3	5A	Aug. 13	166	6	156	{ 3@ 45 1@160 1@240 }	.....do.....	{ A-27 B-1 C-8 }	21	15	3	56	33.8	35.9
Aug. 4 to Aug. 6	7	Aug. 31	5,400	7.5	4,793	{ 3@ 45 1@160 1@240 }	.....do.....	{ A-27 B-1 C-8 }	814	828	74	1,746	40	45
Aug. 13 to Aug. 16	10	Sept. 27	5,400	4	5,216	{ 3@ 45 1@160 1@240 }do.....	{ A-28 B-1 C-6 }	1,096	993	90	2,119	38.9	40.6	Total mines destroyed in- creased by 17 swept up by the British while clearing their mine fields.
Aug. 16 to Aug. 17	4	July 30	5,399	14	5,013	{ 3@ 80 1@160 1@240 }	.....do.....	{ A-28 B-1 C-6 }	939	745	74	1,758	32.6	37.9
Aug. 21 to Aug. 21	2	July 1	2,220	4.5	2,120	{ 2@ 80 }	.....do.....	{ A-28 B-1 C-6 }	317	216	22	572	25	26.2
Aug. 24															
Aug. 25 to Aug. 20	1	June 8	3,385	3	3,285	{ 1@ 80 1@160 1@240 }do.....	{ A-28 B-1 C-6 }	523	630	50	1,203	35.5	36.8	Made preliminary sweep of northern three lines only on account of British line of mines RQ1, which was still unswept. See seventh op- eration.
Aug. 30 to Sept. 5	13	Oct. 26	3,760	4.5	3,595	{ 2@ 45 part 6@ 45 }	.....do.....	{ A-28 B-1 C-6 }	1,189	194	33	1,416	37.7	39.4
Sept. 4 to Sept. 8	8	Sept. 7	4,920	13	4,290	{ 6@ 45 }	.....do.....	{ A-28 B-1 C-6 }	927	212	32	1,171	.....	.....

1 Estimated.

Sixth.....

Summary of United States minesweeping operations in the North Sea barrage—Continued.

No. of operation.	Date begun and date ended.	No. of group.	Mine-laying data.				Num-ber and depth of lines.	Method of sweeping.	Average vessels employed. A=Sweep-ers. B=Frawl-ers. C=Chas-ers.	Mine-sweeping data.				Percentage of mines in place after 1 year.		Remarks.
			Date laid, 1918.	Num-ber laid.	Ex-ploded on lay-ing.	Num-ber mines which sur-vived.				Mines cut.	Mines ex-ploded.	Mines coun-ter-mined.	Total mines de-stroyed.	Based on col-umn 5.	Based on col-umn 7.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
					<i>Per ct.</i>		<i>No. Ft.</i>							<i>Per ct.</i>	<i>Per ct.</i>	
	Sept. 8 to Sept. 10	7	Aug. 31	5,400	7.5	4,793	2@ 45 1@ 160 1@ 240	.....do.....	A—28 B—1 C—6	152	374	37	2,158	40	45	Completed sweeping western end left on fifth operation. Total mines destroyed increased by those swept on fifth operation plus 38 mines destroyed on final clearance sweep.
Seventh...	Sept. 17 to Sept. 19	8	Aug. 7	4,920	13	4,290	6@ 45	.....do.....	A—28 B—1 C—6	391	88	7	1,761	35.8	41.2	Completed sweeping this group as soon as British finished their line R.Q.1. Total mines destroyed is increased by those swept on the sixth operation plus 104 destroyed by British while clearing their line R.Q.1.

SUMMARY OF FINAL CLEARANCE SWEEP, SEPT. 8 TO 30.

Date.	Sept. 8.	Sept. 9.	Sept. 10.	Sept. 11.	Sept. 11.	Sept. 12.	Sept. 12.	Sept. 12.	Sept. 12.	Sept. 13.	Sept. 22.	Sept. 24.	Sept. 25.	Sept. 27.	Sept. 28.	Sept. 29.	Sept. 30.	Total.
Group.....	7	7	7	12	11	12	11	11	11	9	8	12	5, 6	11	11	6, 3	9	.....
Cut.....	9	2	8	1	1	11	7	11	11	1	3	.....	.....	.....	4	.....	.....	47
Exploded.....	13	3	3	.....	2	20	9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50
Countermine.....	2	.....	.....	.....	.....	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
Total.....	24	5	11	1	3	33	17	3	33	1	3	.....	.....	.....	4	.....	.....	102

1. Total mines laid by United States in North Sea barrage..... 56,611
2. Total United States mines which survived after premature explosions..... 52,219
3. Total United States mines accounted for in sweeping operations..... 21,295
4. Percentage of United States mines accounted for in sweeping:
 - (A) Based on total mines laid..... 37.6
 - (B) Based on mines which survived laying..... 42.7
5. Total British mines destroyed by United States forces..... 27

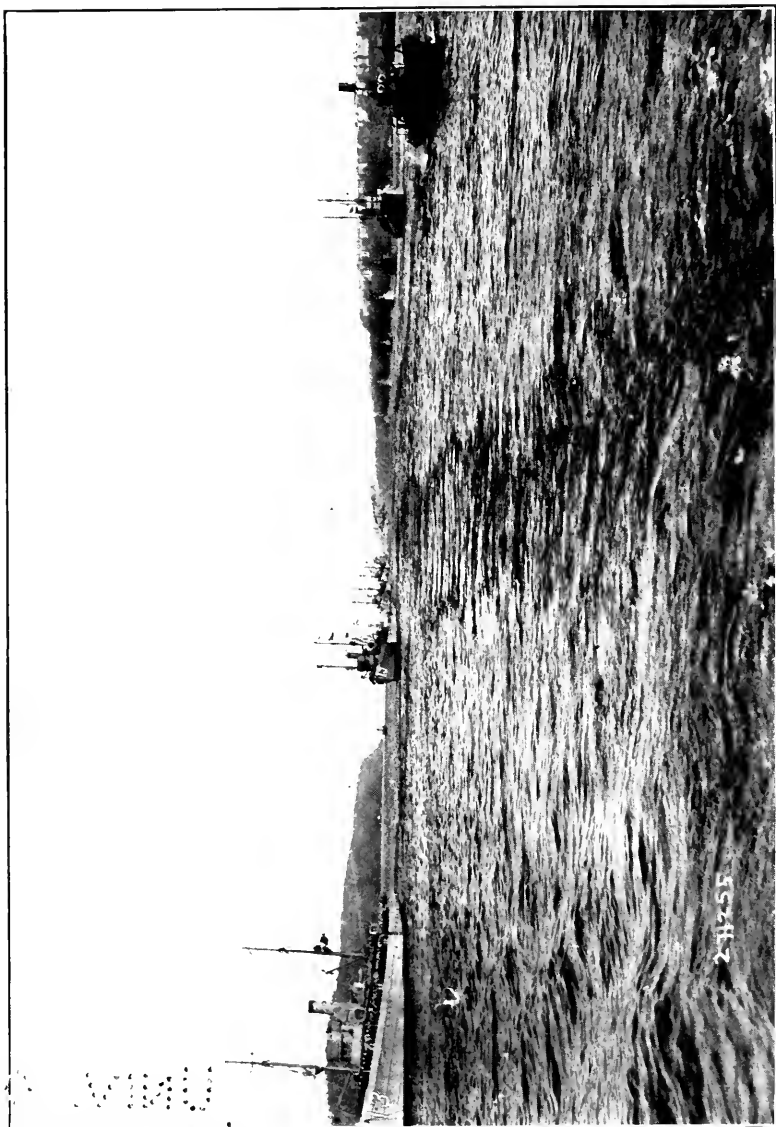
CHAPTER X.

RETURN TO THE UNITED STATES AND DISBANDMENT OF THE NORTH SEA MINE FORCE.

Had it not been necessary to return the sub chasers to the United States the problem of getting home would have been a very easy matter. Efforts to sell these vessels in Europe had been unsuccessful, and to lay them up in a British port until the following summer, when the weather conditions would have been more suitable for the long return voyage, would have been unduly expensive. As previously stated, it had been decided that they should be taken home escorted by the minesweepers. A southern passage across the Atlantic was chosen in order to break up the trip by stops at Lisbon, the Azores, and Bermudas, and with the expectations that the weather would be more favorable than on a northern route.

By the time that the sweeping operations had been completed all the chasers except two had been sent to Devonport for docking prior to their trans-Atlantic voyage. The six remaining British trawlers were being sent to Harwich, England, as fast as they could be spared and there were turned over to the British Admiralty. The British auxiliaries which were operating under our orders were similarly turned back to their owners as rapidly as their services with the mine force could be dispensed with. A small cargo vessel, the U. S. S. *Lake Freed*, had arrived at Kirkwall in the early part of September in response to a request of the commander of the Mine Force, and was loaded with the various minesweeping gear which could not be carried by the repair ships or the sweepers. This gear consisted principally of about 2,000 sphero-cylindrical steel buoys which had been sent from the United States with the expectation that they would be required for buoying the sweep wire to keep it from dragging on the bottom. Due to the adoption of a shorter sweep wire than originally contemplated, these buoys were found not necessary for this purpose, but had proved most valuable for making the marker buoys which were used in marking out the mine fields. As soon as the *Lake Freed* had been loaded the store base on Carness Point at Kirkwall was demobilized and turned over to the British.

Besides the gear at Kirkwall, there was still a quantity of material at Inverness which had also to be returned to the United States. This material also was loaded on the *Lake Freed*, and by the 17th of



Mine-sweeping detachment reviewed by the Secretary of the Navy, in the North River, on the return to the United States.
Turkey (13) and Quail (15). (Page 74.)

September Base 18 at Inverness had been completely demobilized and was turned over to the British senior naval officer at 10 o'clock that date.

This base had been in operation for almost two years, and during that time had served many purposes. During the summer of 1918 it had assembled and loaded on the minelayers approximately 25,000 mines. After the minelaying had been completed the base had been the home of the early sweeping operations and had also acted as a training and assembling station for two of the crews which manned the German merchant ships taken over by the United States. After the minesweeping detachment had moved to Kirkwall the base still proved invaluable. Large quantities of provisions had been left in store at the base when the minelayers had returned to the United States and, augmented by additions from Liverpool, were sufficient to supply the force at Kirkwall throughout the summer. In addition to this, the base acted as a receiving and shipping depot for the tremendous quantity of supplies which were constantly required to enable the minesweepers to continue operations. Almost a constant procession of trawlers or sweepers plied between Kirkwall and Inverness, frequently towing barges loaded with supplies in addition to the quantities that had been placed on board.

On October 1, the day after the sweepers had returned, the *Black Hawk* and 14 of the sweepers sailed for Devonport. The *Eider* and 6 other sweepers had proceeded direct to Invergordon from the mine field in the order to obtain about 700 drums of gasoline shipped there from Inverness which was to be used for the sub chasers. The *Quail* and *Auk* were detailed to escort sub chasers 164 and 206—the only chasers which had not already sailed for Devonport—and refuel them with gasoline, since no supply was available at any English port.

The general plan for taking the chasers home consisted in towing them as long as the weather permitted, and in case the sea became too rough they were to be cast off and travel under their own power. Each sweeper which had been designated to tow a chaser and four additional stand-by vessels were given approximately 75 drums of gasoline in order that it might be possible to refuel the chaser at sea should such a procedure become necessary. Since there were a great many more sweepers than chasers it was not necessary that they should all proceed in company, and arrangements were made for 5 of the vessels, including the *Patapsco* and *Patuxent*, which had been in European waters longer than any of the other ships in the detachment, to proceed direct to the United States as soon as routine overhaul could be completed in Kirkwall. This division got underway October 6 and proceeded direct to the Azores, and thence to Hampton Roads, reaching the United States approximately two weeks ahead of the rest of the force.

Of the remaining sweepers the *Oriole*, *Penguin*, *Curlew*, and *Tanager*, which required dock yard repairs before they could attempt a trans-Atlantic passage, sailed for Chatham, where the Force Commander had arranged with the Admiralty to have this work completed. The *Avocet*, *Thrush*, and *Chesapeake* sailed direct for Brest, the first two vessels to tow to the United States the water vessels *Nenette* and *Rin Tin Tin*. The *Chesapeake*, which had been operating with us for the past two months, had reached the limit of her utility as a naval vessel and was to be put up for sale.

The *Black Hawk*, accompanied by the *Oriole*, while en route to Devonport stopped at Gravesend to land the Commander of the Mine force in order that he might proceed to London. A general railroad strike was in progress at the time, which had made travel practically impossible in Great Britain except by means of motor transportation. The admiral's automobile, which had been placed on board at Kirkwall, was landed to enable him to proceed to London, and later to Southampton, England, where he embarked upon the *Adriatic* to return to the United States in order that the arrangements might be completed for the disbandment of the force upon its arrival home. Commander W. L. Beck accompanied the admiral as far as London in order to attend a conference of the International Mine Clearance Committee, which desired to discuss problems which had arisen in connection with the minesweeping operations, prior to the departure of our North Sea forces for the United States. Admiral Strauss, in addition to Commander Beck, attended the conference in case any questions should arise in connection with the methods or completeness of the removal of the American mines from the North Sea barrage.

While repairs were in progress at Devonport effort was made to give the men as much liberty as possible, as well as an opportunity to visit London and other parts of Great Britain before returning to the United States. Owing to the riot which occurred in Plymouth between the American sailors and the civilian population several months before, there was apparently a tendency on the part of the populace to reopen the old brawl. Small fights broke out the first day that liberty was granted, and regardless of the heavy patrol that was established, the conditions grew worse and worse, finally culminating in the death of an American bluejacket who was assaulted by a civilian. Liberty was stopped for the remainder of the stay in England.

As the repairs at Devonport and Chatham drew to an end, the minesweeping force was divided into two detachments for the trip home, as had been previously decided, with a view of reducing the congestion while the vessels were in harbors and thus enabling them to obtain fuel and water more easily. On the 12th of October the

Panther and 12 of the sub chasers sailed from Devonport to Brest, France. They were followed two days later by 14 of the mine-sweepers. On the 15th the *Black Hawk* and the remaining sweepers and chasers, except the *Swan*, *Auk*, *SC-164*, *178* and *206*, got under way for Brest. The repairs were completed on these latter vessels the day following the departure of the *Black Hawk*, when they got under way. In the meantime three of the vessels which had been sent to Chatham were completed and were on their way to Brest to join the remainder of the detachment. The repairs on the *Penguin* required more time than had been expected, and it was necessary to hold her at the dockyards for several additional days.

Although there was plenty of fuel, water, and gasoline available at Brest, considerable difficulty was encountered in getting it on board the vessels. Four days were required before the *Panther* and her detachment of 12 sub chasers and 14 sweepers could get under way for Lisbon. The *Black Hawk* and the remainder of the sweepers and chasers, however, managed to sail after two days in port.

The *Panther* and her convoy arrived in Lisbon on October 20, followed by the *Black Hawk* detachment two days later. The object in stopping at Lisbon was to break the trip for the sub chasers on account of the discomforts in living aboard those vessels while at sea. The weather, however, was so good during this part of the voyage that the force could have proceeded direct to the Azores from Brest with almost equal comfort. Lisbon, however, was a pleasant town and offered many attractions and diversions for the men in the detachment, and even though it postponed the final date of arrival in the United States, the days spent there were apparently much enjoyed by the personnel. After two days spent in port the two detachments, separated by an interval of one day, got under way for Ponta Delgada in the Azores.

The weather continued fine for the next leg of the cruise and the two detachments reached the Azores on the 27th and 28th of October, respectively. The small harbor at Ponta Delgada was taxed almost to its maximum capacity by the arrival of the 55 vessels in the two detachments. There was much difficulty in obtaining water and provisions at the Azores. The facilities for supplying water were inadequate and, in addition, the local authorities gave merchant ships precedence. Over 500 tons of water were required by our vessels, but only 100 tons could be obtained, and it was necessary for the *Black Hawk* to remain there a day and a half longer than desired in order to get this. The problem of obtaining fresh provisions was equally difficult. There apparently was plenty of beef and vegetables available on the island, but on account of the very bitter rivalry between the contractors at Ponta Delgada the firm which

underbid the others was prevented from delivering its produce to our ships.

In the meantime the *Penguin*, which had completed her repairs at Chatham, had arrived at the Azores with the U. S. S. *Concord*, which she was escorting.

On the evening of the 29th of October the *Panther* and her detachment sailed from the Azores for the Bermudas. Two days later the *Black Hawk* detachment sailed, and they in turn were followed by the *Penguin* and *Concord* on October 31.

The excellent weather which had prevailed up until the arrival at the Azores was now replaced by a succession of gales for the next two weeks. During 10 of the 13 days which were required for the passage from the Azores to Bermuda, the wind averaged from force 4 to force 8, and three-quarters of this time it was practically dead ahead. At times the ships were barely able to make headway through the heavy seas.

The third day out from the Azores sub chaser 256, which was then in tow of the U. S. S. *Falcon*, was destroyed by a fire following a gasoline explosion. The fire spread so rapidly that the vessel was completely in flames before measures could be taken to save her. All the men on board, several of whom had been badly burned, succeeded in getting clear of the vessel and into the water, where they were rescued by the vessels in the near vicinity. As soon as the sweepers could get within range of the burning chaser they turned their fire hose on her, but the fire was so intense that she continued to burn to the water line and shortly afterwards disappeared. The court of inquiry which was convened upon arrival at the Bermudas concluded that the accident was caused by the gasoline tanks breaking adrift due to the heavy rolling of the vessel at the time, and, having broken adrift, the tanks became ruptured allowing the engine room to be filled with gasoline vapor which was ignited probably by the auxiliary engine or the fan motor.

The storms, coupled with the short amounts of fuel which it had been possible to obtain at Brest, caused several of the vessels to run short before they reached Bermuda. The *Turkey* was towed a portion of the distance by the *Panther*; the *Swallow* and *Auk* were oiled at sea by the *Black Hawk*; and several of the sub chasers were given gasoline at sea. The *Seagull* ran entirely out of oil, so that she could not maintain fires under the boilers long enough to operate her radio and report the seriousness of her condition. The engineer officer, however, managed to connect the generator of the radio apparatus to the engine in the motor sailing boat and operated it for a sufficient length of time to enable the *Seagull* to call for assistance. The *Black Hawk*, which was practically the only vessel that still had

a reserve supply of oil on board, proceeded to the assistance of the *Seagull*.

The vessels of the two detachments blown apart by the severe storm of the last three days straggled into Bermuda, arriving singly or in groups between the 9th and 13th of November. The gale made the entrance through the narrow channels to the inner harbor extremely difficult, and even after the vessels had succeeded in getting inside several lost their anchors shortly after they had dropped them on account of the strength of the wind that was blowing.

By the evening of the 15th the *Panther* detachment was ready to sail. Another storm had sprung up in the meantime and the dockyard officials were much surprised that we should send such tiny vessels as the sub chasers to sea under such adverse weather conditions. The chasers had, however, shown their ability to weather in safety gales far worse than the present one, and no hesitation was felt in getting underway. The following day the remaining vessels, except the *Black Hawk*, weighed anchor and stood out of the harbor. The weather having been too severe for the dockyard to take the *Black Hawk* alongside the oil dock, it was necessary for her to remain until the 17th in order to get oil.

While in Bermuda a radio message had been received from the Secretary of the Navy inquiring what day we would arrive at Hampton Roads (which was originally intended as the destination of the minesweepers), and also whether it would be possible to proceed from there to New York in time to arrive at that port by the 18th of November. This was not, however, possible and as an alternative it was suggested that the force proceed direct to New York instead of by way of Hampton Roads. The recommendation was approved and the orders to the vessels which were then ready to sail were accordingly modified.

The two detachments arrived off Tompkinsville, N. Y., on the 19th and 20th of November. Shortly after the *Black Hawk* had anchored Admiral Strauss returned on board and rehoisted his flag. The force was to be reviewed on Monday the 24th, and the following day the North Sea minesweeping detachment would be disbanded and various sweepers would proceed to different navy yards to undergo repairs before joining the new organizations to which they were to be assigned. The sub chasers would report to the Commandant Third Naval District to be dismantled and placed on sale.

On the 21st of November the vessels shifted berth to the North River, the sweepers anchoring in two columns with the sub chasers tied up alongside.

The representatives of the Y. M. C. A., the K. of C., and the W. C. C. S. boarded the ships, distributing candy and tobacco and

telling the men of the various entertainments which had been arranged for them. Dances, boxing, theaters, and sight-seeing trips were all included in the program of amusements which were to occupy their every moment.

At 10 o'clock on the morning of November 24 the Secretary of the Navy reviewed the North Sea Mine Force from on board the U. S. S. *Meredith*. After steaming up one side of the formation they returned on the other side, then the reviewing party went on board the U. S. S. *Heron*, one of the sweepers, to inspect her.

The review was followed by a reception given by the Secretary on board the U. S. S. *Columbia* to the officers of the mine force and their wives. Simultaneously a luncheon was given by the K. of C. to 2,000 of the enlisted men at the Astor Hotel.

At midnight November 24, 1919, the flag of Rear Admiral Joseph Strauss, United States Navy, who had been in command of the Mine Force United States Atlantic Fleet (although this organization later became known as the North Sea Mine Force when the fleets of the Navy were reorganized in the spring of 1919) during the construction and destruction of the North Sea barrage, was hauled down, and at the following noon the force was disbanded.

And so ends the story of the northern barrage. In five months the building of a barrier of mines from Scotland to Norway had been accomplished. Peace came and in less than 11 months after the signing of the armistice the task of removing those same mines had been completed; and in so far as mines laid by the United States Navy were concerned as a menace to navigation the North Sea was again made safe for world commerce.

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CHART

OF

Central Section of the North Sea Barrage
Showing Marker Buoys Laid to Define the
Lines of Mines Preliminary to
the Sweeping Operations

TO ACCOMPANY
MONOGRAPH No. 4

"The Northern Barrage (Taking up the Mines)"

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SHOWING
POSITIONS OF LINES AND DEPTHS
OF ALL
AMERICAN AND BRITISH MINES
IN AREA APPROX.
SHEET 5

British Mine laid at depth of 10 fms.
American Mine laid at depth of 10 fms. (10 fms. 10 fms. 10 fms.)

Indicates position of mine

CENTRAL SECTION
OF THE
NORTH SEA BARRAGE
SHOWING
MARKER BUOYS LAID TO
DEFINE THE LINES OF
MINES PRELIMINARY
TO THE SWEEPING
OPERATIONS

014 depth 10 fms. 10 fms. 10 fms.
015
016 depth 10 fms. 10 fms. 10 fms.
017
018 depth 10 fms. 10 fms. 10 fms.
019

020 depth 10 fms. 10 fms. 10 fms.
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